JOURNAL

OF THE

FRANKLIN INSTITUTE

Of the State of Pennsylvania,

AND

MECHANICS REGISTER;

DEVOTED TO

Mechanical & Physical Science, the Arts & Manufactures,

AND THE RECORDING OF

AMERICAN AND OTHER PATENTED INVENTIONS.

FEBRUARY, 1836.

Practical and Theoretical Mechanics.

Report of Experiments made by the Committee of the Franklin Institute of Pennsylvania, on the Explosions of Steam-Boilers, at the request of the Treasury Department of the United States.

(*Continued from page* 20.)

IV. The next query may be thus stated: *when steam, surcharged with heat, is produced within a boiler by the contact with heated metal, does this steam remain surcharged, or does it take up water from contact with that in the boiler, and become saturated steam?* If the latter supposition be correct, at what pressure and temperature with regard to the temperature of the surcharged steam, and to that of the water on which it rests?

The answer to this question is given by the experiments just detailed; and as they established the negative in relation to the surcharged steam becoming saturated, there was no necessity for a repetition of the experiments to ascertain the precise temperature of the water in the boiler. When fire was applied to the top of the boiler, the water within was at 318° Fah.; a moderate fire was kept up below, and one so nearly uniform, that great variations from that temperature could not have taken place, and which the results satisfactorily show, did not occur. If we assume that during the experiments the temperature was 308½° Fah., a remarkable correspondence will be found in the observed pressures, and in those calculated on the supposition that this steam was expanded by heat, as a gas would have been, without any addition of water. The table below gives the temperatures of the surcharged steam observed at different times during the course of the experiments; the pressure shown by the gauge at that temperature; the pressure which would have been produced by heating steam at 308½° to the temperatures given in the first column by the mere effect of expansion; and the pressures of saturated steam at the different temperatures.

Temperatures of surcharged Steam.	Corresponding pressures from experiment.	Pressures calculated from expansion of Steam, 308½° by heat.	Pressures of saturated Steam at the different temperatures.
308½		5.2	
376	5.7	5.6	10.4*
462	5.8	6.2	31.6
506	6.1	6.5	48.0
526	6.6	6.7	57.3
533	6.8	6.75	61.1

A comparison of the second and third columns shows that in these experiments, which lasted more than two hours, the surcharged steam remained in contact with water without acquiring from it the water necessary to convert it into saturated steam, but retaining its surcharged state. There is nothing to warrant the belief that any of the surcharged steam was condensed by the water.

V.—*Inquiry in relation to Plates of Fusible Alloys.*

It is well known that one of the most scientific nations of Europe relies, particularly, as a means of safety for steam boilers, on the use of plates of fusible metal. The plates are alloys of tin and lead, or of these two metals with bismuth, the proportions of the component metals regulating the point at which they fuse. In France these alloys are prepared at the royal mint, where plates made from them, or ingots of the alloys may be purchased for use. The examinations which must have been made to determine the proportions of the metals necessary to produce an alloy fusing at a given temperature, and the circumstances of fusion, have not, as far as the committee know, been made public. A table of the fusing points of different alloys of tin, lead, and bismuth, &c., was drawn up by Parke, from experiment, and is contained in his chemical essays, vol. ii. page 615. This table was made the basis of the investigations† undertaken by the committee, but they soon found it convenient to depart, more or less, entirely from it.

The method employed by Parke for determining the fusing point of a metal, or rather the solidifying point of the melted metal, was ingenious. On melting a metal, and allowing it to slowly cool to the point of congelation, and observing a thermometer plunged in it, a rise of temperature, and then a stationary point, is observed; this is a point where a change is going on, by which the heat given out in the change is equal to that of which the metal is robbed by the surrounding medium. This point usually coincides with the passage of the metal to the solid state, from what may be either the liquid state, or a semi-fluid state, similar in aggregation to sand; sometimes the alloy is solid throughout, before the stationary point arrives; and sometimes there is more than one such point.

The stationary point is not that at which the alloy, when used as a fusible plate for a boiler, gives way; the plate being covered by a perforated brass disk, to prevent its being pressed outwards before fusion, and so reduced in

* These numbers are obtained from the table of Arago and Dulong, by interpolating between the terms; and though not rigidly correct, are abundantly so for this purpose; the last two numbers are obtained, by substitution, in the formula given by these experimenters, as resulting from their observations.

† At the time these experiments were made, the paper of Rudberg Ann. de Chimie. et de Phys. Vol. 48, had not appeared.

thickness as to burst, the metal is not forced out through these openings until perfectly fluid; if any part of the metal becomes fluid before the rest, and gives way, the rest being in the sandy state, just spoken of, the particles seem to act like those of sand in a similar case, and to oppose an effective resistance to the pressure of the steam; these facts will be further developed in the examination of the application of these plates.

The stationary points, when taken with due reference to the state of the metal at the time, afford so many approximate marks by which to compare together the fusibilities of the plates, and to ascertain whether they bear a due relation to each other, when fused, in place upon the boiler; and to study the alloys themselves. In composing alloys of the metals, before referred to, the tin was fused first at as low a temperature as possible, then the bismuth and lead added, the heat being kept up; these metals were readily taken up by the liquid tin, and were thus little exposed to oxidation: the surface of the alloy was always protected by a stratum of oil. The metal was constantly stirred to promote the uniform diffusion of the different metals throughout each other.

The alloy being liquid, a thermometer, of which the errors had been carefully ascertained, was plunged into it, and the fall noted until it reached the lowest point; the rise to the stationary point followed, and at this the thermometer usually remained for such a length of time, often some minutes, as to render any error of observation unnecessary. Some of the alloys have no stationary point, properly so called, and the beats of a second's pendulum were used to determine the rate of their loss of heat. When the quantities of metal used were inconsiderable, the heat was observed to be carried off so rapidly as to lower, or entirely to destroy, the stationary point: to avoid this, the crucible containing the alloy, was placed in a second one, the edges of the former resting on the middle of the sides of the latter. The quantity of metal used was never less than between five and six ounces, troy.

The stationary point being at the passage of the liquid metal to the solid state, or at some interior change of the solid itself, the thermometer was entangled in the metal; and in moving the alloy, to remelt it, the instrument was endangered.* This was remedied by the use of a small cylinder of very thin sheet iron, containing mercury. This cylinder was placed in the alloy, and filled up to the surface of the metal with mercury, and the thermometer could now be readily placed and removed. Care was taken to ascertain that the stationary point, given in the cylinder, was the same with that shown by the naked thermometer. As some of the alloys expanded considerably on congealing, it was supposed that the cylinder might prevent error from the compression of the bulb of the thermometer, but no such compression in the instrument used was detected by frequent trials.

As the alloys were intended for ordinary use, it was deemed advisable to ascertain how far the impurities of the metals, as they occur in commerce, would cause a variation in the fusing point. Tin has a very uniform purity in commerce, the grain or stream tin being always accessible. The bismuth of commerce being obtained principally from the native bismuth, is probably not very variable.† The lead contains variable quantities of silver, copper, and iron. The first experiments were made on the fusing point, on various specimens of common tin: this tin showed, by reagents, a trace of iron and of copper, as impurities. The fusing point of grain tin is 442° F.

* Although the instrument was frequently used in determining the stationary points, no permanent changes in the indications of the instrument, such as was noticed by M. Rudberg, took place.

† It is proper to state, however, that some specimens were procured, obviously obtained from the sulphuret, and contaminated with it. They were not used.

COMMON TIN.	*Stationary Point.*	*Remarks.*
Specimen, No. 1.		
First experiment,	441.75°	Thermometer in cylinder.
Second, do.	442.25	do. do.
Third, do.	441.75	Without cylinder. Stirred.
Fourth, do.	442.00	do. do.
Mean,	441.94	
Specimen, No. 2.		
First experiment,	441.50	In cylinder.
Second, do.	442.00	do.
Mean,	441.75	
Specimen, No. 3.		
First experiment,	438	In cylinder.
Second, do.	439	do.
Mean,	438.5.	
Specimen, No. 4.		
First experiment,	441	Thermometer in cylinder.
Second, do.	443	do. do.
Third, do.	441½	Without cylinder. Stirred.
Fourth, do.	443	do. do.
Mean,	442.12	
Specimen, No. 5.		
Single experiment,	442	In cylinder.

The fusing points of the different specimens varied slightly, but the differences, in a practical point of view, are nothing.

The fusing points, in the case of tin, coincide nearly with the stationary points, the metal passing rapidly from the liquid to the solid state. When the change of state is rendered more rapid by agitation, the stationary point is slightly raised; the heat, which is produced in the change, not having time to be carried off, as when the change is allowed to proceed by degrees.

Lead from the Paris mint, of the kind used for cupellations, and containing a very minute quantity of silver, as an impurity, was next compared with the common lead used by plumbers. The experiments were as follows:

Pure Lead.	*Stationary Point.*	*Common Lead.*	*Stationary Point.*
First experiment,	601°	First experiment,	604°
Second, do.	601	Second, do.	604
Third, do.	602		
Fourth, do.	602		
Mean,	601.5	Mean,	604

An attempt was next made to ascertain what effect the impurities shown by the fusing point of lead would have upon the fusing points of alloys, into which it entered. Alloys, in atomic proportions were selected, as much was expected from them in the way of avoiding the slow passage from the liquid to the

solid state, which was observed to be the property of certain mixtures of the metals. Alloys of tin and lead were therefore made in atomic proportions; first, of grain tin and the lead already spoken of, from the Paris mint; the second, of block tin and common lead. The tin was employed in multiple proportions, as being the more fusible metal, it would probably enter more largely than the other, into the composition of fusible plates for steam-boilers. The equivalent of lead is 104; of tin, 58; the first alloy was composed of the two metals, united in this proportion, the total weight of the components being about ten ounces, troy; a new equivalent of tin was next added, and so on, through the series: the results are given in the following table.

Equivalents of Pure Lead.	Equivalents of Grain Tin.	Stationary point.	Number of Observations of which the stationary point is the mean.	REMARKS.
1	1	354¼	2	Begins to lose fluidity at 430°, soft solid at 410°, do. 400°, still yields to a stick at 350½°, rises to 354¼, the stationary point, hard and unyielding.
1	2	357¼	2	Thermometer fell to 356½°, metal still liquid, congeals very irregularly, rises to stationary point, parts of the metal still fluid.
1	3	357½	1	
1	4	358¼	2	Thermometer fell to 365°, rose rapidly to 369°, where it was stationary for a short time, then fell to 357½, where it was stationary for some minutes.
1	5	357¾	5	Thermometer was 30 secs. in falling from 369½° to 362½, very slow: stationary at 357¾ for 100 secs. No other stationary point to 200°.
1	6	358¼	4	Thermometer stationary at 377°, in one experiment, then fell to 358°, stationary 35 secs.: at 377 soft solid, easily penetrated, hard at lower stationary point. In another expt. fell to 377°, then rose to 379°, whence it fell rapidly to 358¼°, the lower stationary point.

Equivalents of Common Lead.	Equivalents of Block Tin.	Stationary point.	Number of Observations of which the stationary point is the mean.	REMARKS.
1	1	354½	1	At 408½°, a stick only pierces the surface, solid below. Thermometer fell to 352°.
1	2	357½	5	Parts of the alloy liquid at stationary point.
1	3	357¾	1	
1	4	359¾	2	In one experiment therm. rose from 366½° to 367°, alloy granular, semi-solid; fell to stationary point, alloy solid. By stirring the upper point was obliterated.
1	5	360½	2	In one experiment the therm. rose half a degree from 376½°, then fell rapidly to stationary point.
1	6	359¾	2	Therm. rose half a degree above 383½°, in one experiment, and was stationary a short time at 381½°, in another experiment; at both these times the metal was beginning to lose fluidity. Solid at lower stationary point.
1	7	359¾	1	Thermometer fell very slowly from 387° to 386¼, and alloy began to congeal at surface.

Upon this table we remark, first, that at all the stationary points, except in the alloy of 1 lead to 2 tin, the metal was solid at the stationary point; second, that although the proportion of tin varied from one to six, and even to seven, the stationary point was not changed more than $3\frac{1}{2}°$ for the first series, and $5\frac{1}{4}°$ for the second; third, that in the proportion of one of lead to four of tin, a second stationary point appeared at the point at which the metal began to lose its entire fluidity, and was found in the higher parts of the series, rising with the increased proportion of the more fusible metal, with difficulty detected at times, and disappearing by agitation of the alloy; fourth, that the tin and lead of commerce give, for the lower stationary points in the same alloys, quantities nearly the same. A comparison of the upper stationary points appears below.

Equivalents of Lead.	Tin.	Upper Stationary Point for Pure Metals.	Upper Stationary Point for Common Metals.
1	4	369°	367°
1	5	369	$376\frac{1}{2}$
1	6	378	$382\frac{3}{8}$

The variable nature of the results, seems to point out rather the difficulty of detecting the upper point and the effect of accidental circumstances, than that it is affected materially by the impurity of the metals as found in commerce. This upper point rises with the proportion of the less fusible metal. The number of degrees between it and the corresponding point, for the solid state of the metal shows one difficulty to be obviated in the use of the fusible alloys. For example, the first in the table, just given, has $10\frac{3}{4}°$ between the point at which it begins to lose fluidity, and that at which it is solid; the second has $11\frac{1}{4}°$, and the third $29\frac{3}{4}°$; these defects, it was hoped, would not have been found in alloys in definite proportions. They indicate that the variety of combinations in definite proportions is not considerable, if even it exceeds a single one; and that when the metals are mixed in definite proportions, the alloys are in fact combinations, or mixtures, of one or more chemical compounds with the metals themselves. If this be the case with alloys in which the proportions are in the ratio of the equivalents or in multiple ratios, it would seem to follow certainly, that in alloys made in proportions not definite, the same fact would appear. That this is so, and that its effects are of importance in practice, will appear subsequently.

The second part of the inquiry relates to the action of fusible plates when in place on the boiler; it supposes proper alloys, fusing at required temperatures, to be composed, and then studies the causes, modifying the action of them when placed on the boiler. In the first apparatus for the use of these plates, the attempt was made to introduce them within the boiler, but the difficulty of replacing a plate which had fused by another plate, led to the abandonment of this apparatus. The opening made in the boiler, when the plate was withdrawn, was so great that the contents of the boiler were violently discharged through it, before the operation of replacing the plate could be effected. This observation has a bearing upon the plans for making large openings in boilers of full size, to avoid explosions.

The apparatus finally used was a sliding plate, moving in a groove upon the upper side of the boiler, as shown in Plates 1 and 3, where *s* represents the slide moved by the lever *r*; in the middle of the slide was an aperture slightly conical, for receiving the fusible plate, this aperture was eight-tenths of an inch in diameter. By means of the lever, the plate could be brought over an opening in the top of the boiler, or the solid part of the slide might be made to cover the same opening. The fusible plate was covered by a disk of brass, the edge of which projected over the plate, and rested upon the slide. There were six holes drilled through this plate, each being about nineteen-hundredths

of an inch in diameter. To retain the slide in its place, when pressed from below, and to retain the fusible plate when in a similar situation, the forked stem, L, pressed in the former position by one leg, upon the slide, *s*, in the other by the other leg upon the disk covering the fusible plate; the upper end of the stem entered a cavity in an adjusting screw, *t*, passing through the gallows, *u;* by this means allowance could be conveniently made for expansion. The lever for moving the slide rested, when the aperture in this latter for receiving the fusible plate coincided with the opening in the boiler, against an upright, projecting from the top of the boiler, and serving as a stop. By the use of this apparatus, the plates were applied very readily, were removed when fused, and the opening into the boiler closed with so much despatch as to prevent the foaming within from taking effect. The disk which covered the fusible plates, prevented in part the loss of heat from the upper surface.

The plates which were first cast, were intended for low pressures as most convenient for experiment, they were fifteen-hundredths of an inch in thickness. The observations made upon the manner in which they acted when in place upon the boiler, led to the question of the effect of varying the thickness upon their use. When a plate of sufficient thickness to prevent its giving way to pressure, verges towards its point of fusion; the top part, which is in contact with the metal disk, melts, and flows over the holes in the disk; sometimes it accumulates until the liquid rolls off the plate. The temperature rising, a small pellet of the more perfectly fused parts is thrown out by the steam, the flow of which is instantly checked; this is repeated frequently, until a breach through the plate is made, and the uninterrupted flow of steam takes place. If the plate be removed at once, a very small hole appears, which would gradually have been widened by the action of the escaping steam, probably before the entire fusion of the plate. The under surface of the plate appears oxidized and the fusion to have taken place at the top: the plate has contracted in its dimensions, and the periphery of the upper surface has lost its circular figure, which is tolerably well preserved by the lower surface. To give some idea of the extent to which a plate such as just supposed, may lose its substance before giving way, two measurements are subjoined. Before fusion, the diameter of the upper surface of the plates was eighty-four hundredths of an inch; the lower diameter eighty-two hundredths of an inch; the thickness of the plates, fifteen hundredths. After the plate had given way, the diameter of the hexagonal figure into which both the surfaces had passed, was about seventy-nine hundredths for the first, seventy-four hundredths for the second; the diameter of the lower surface, which was still nearly circular, was, for the first, seventy-six hundredths; for the second, sixty-nine hundredths; the thickness of the first was about twelve-hundredths, of the second, one-tenth of an inch; the thickness not being uniform in all parts. The first plate had lost, therefore, nearly three-tenths, and the second half of its substance, without allowing the passage of steam.

The observed oxidation of the lower side of the plate, led to the supposition that it might retard the fusion of the plate, but no confirmation of this view was given by comparative experiments, with plates of which the lower surface was brightened, and of others in which the same surface was highly oxidated, the thickness in each case being the same.

In the course of the experiments on the effect of oxidation, the plates were much reduced in thickness by filing away the under surface, and the fusion of the thinner plates took place at points so much lower than those at which the thicker plates of the same alloy gave way, so as to require an examination of the cause.

Before proceeding with further detail, it may be well to state the general method of experimenting upon the plates. The stationary point of an alloy having been determined, and remarks made as to its point of fusion, plates

were cast from it; and one of these being placed in the opening in the slide of the apparatus already described, was covered with the pierced disk, and the slide moved so as to bring the plate over the opening in the boiler. The steam was now raised, the temperature being noted from time to time, until the plate gave way; steam was then let off to keep the temperature from rising; the plate, which had just fused, removed, and one of an alloy, fusing at a higher temperature, substituted. The steam was again retained, and allowed to rise in temperature, the new plate pushed to its place, and the operation renewed. This course was continued until the alloy, fusing at the highest point of those prepared, had been used, or until the limit of the elasticity of steam, which could be produced in the actual condition of the boiler and state of the fire, was attained; steam was then let off, water thrown into the boiler, and a new series commenced. The tables which will be given, required many days of trial, and of close attention.

To try the effect of thickness on the fusion of the plates, three different thicknesses were cast of each of the alloys used; the first, or thickest, was fifteen-hundredths of an inch thick; the second, eight-hundredths; and the third, four-hundredths. There were five different alloys of tin, lead, and bismuth, composed; the stationary points of which, and the points at which they gave way in the boiler, appear below.

Number of experiment.	Number of alloy.	Temp. at which alloy begins to lose fluidity.	Stationary point determined by committee.	Thickness of plate.	Point at which the plates gave way in boiler.			Mean.	Pressures corresponding to the mean temperature of giving way.	
				Inch's.	Degrees Fah.					
1	1	275	250*		248	249†	249	248.3	1.9	* No true stationary point. Soft solid 250° to 254°.
2	„			.08	243		251	245.5		† Plate blown to pieces.
3	„			.15	250			250	1.95	
4	2	281¾	268‡		263	258		260.5	2.3	‡ Had another stationary point at 207°.
5	„			.08	254½			254.5		
6	„			.15	295	295§	292	294	4.2	§ Piece of plate blown out.
7	3		284		287	288	285½	286.8	3.7	
8	„			.08	290	298		294		
9	„			.15	296	303	304	301	4.6	
10	4	314	309½	.08	299			299	4.5	
11	„			.15	303			303	4.7	
12	5	328	320		298	299	298	298.7		
13	„			.15	314			314	5.7	

The plates of experiments 1, 2, and 3, were exposed to pressures tending to render them of less than one atmosphere; 1 and 3, the two extremes of thickness, show a great uniformity in the point at which they give way, and render it probable that some flaw, in casting the plate number two, caused its fusion at a lower point than that of either of the others; we see too, that at

these low pressures the fusing point in the boiler coincided, very nearly, with the point at which the alloy was a soft solid in the crucible. In this case the thinnest plates, when properly cast, were probably thick enough to withstand the small pressure to which they were exposed, and therefore did not give way at lower temperatures than the thickest, each attaining the temperature at which they were soft solids.

The next series, Nos. 4, 5, and 6, with a less fusible alloy, show, first, that the thinnest plate was too feeble to resist the pressure of steam, and gave way before the metal lost its solidity; second, that the plate, eight-hundredths of an inch, was probably defective, as it gave way at a lower temperature than the thinner plates of No. 4. No. 6 presents a curious fact; the point of yielding of the plate, given by four experiments, is actually above the point at which the alloy from which it was composed became liquid: this would appear inexplicable to one who had not attentively observed the mode of fusion of these thick plates, and would lead to the suspicion of error. The observation of the point at which the alloy became liquid, was however, deduced from three trials; and four experiments, with the plates in place, are given, the extremes differing but three degrees. The explanation is to be found in the mode of fusion already spoken of; the more liquid parts of the alloy are forced out, the less fusible remain, and if strong enough to resist the pressure, the process goes on; this takes place, unequally, in different alloys. The importance of attending to such indications is obvious.

In the next series, the first thickness seems to have been decidedly too weak, and the second to have been hardly sufficient, while the third exhibits a point of fusion when the metal was in a softened state.

In the remaining experiments, both thicknesses were too inconsiderable to sustain the pressure, as appears by comparing the points at which the plates gave way, with the stationary points. Something of this kind seems to have been deduced from practice in the use of these plates in France, for the last royal ordinance, in relation to the means of safety to steam-boilers, prescribes for the plates a thickness of not less than nine-sixteenths of an inch, making of them fusible plugs rather than fusible plates.

Experiments were subsequently made on plates of greater thickness, the use of which led to an interesting termination to this series of experiments. Before, however, stating the results thus obtained, some further experiments with the plates just considered, will be described. These inquiries were directed to the effect which would be produced by the mode of casting the plates, upon their fusibility; it being not improbable that rapid cooling might so modify the physical properties of the alloy, as to change the fusing point from that of the same alloy when slowly congealed.

As low pressures afforded the most easy means of determining this point, plates were cast from the alloys of series No. 1, No. 2, and No. 3, and tried, in place, upon the boiler. Some of the plates were cast from metal at a high temperature, and the mould as cold as the perfect casting permitted; others, of the same alloy, in a heated mould allowed to cool slowly; and others from metal heated to a temperature as little above the point of fusion as possible. In the case of the higher temperatures, care was taken not to raise the heat so far as to oxidate rapidly either of the constituents of the alloys, thus changing the fusing point. A comparison of the results obtained, showed no greater differences than those which have been seen to occur between plates similarly cast, and from the same alloy; and the conclusion derived was, that the mode of casting has no effect on the fusing point, which is appreciable in this mode of applying them. The French instructions expressly recommend to those

who make or use boilers, to obtain plates in preference to the fusible metal in ingots; on the ground that it will be found difficult to procure plates of the same fusibility with the ingot, from that form of the alloy. This remark led to the experiments just referred to, and the explanation of it which they give, refers to the undue heating of the alloy in the casting of the plates, since they show that the particular mode of casting produces no difference worthy to be regarded in a practical point of view.

Plates were now cast quite thick, viz.—one-fourth of an inch, of the alloy of eight parts of bismuth, eight of tin, and seven of lead; this alloy being intended to give way at a temperature corresponding to about one atmosphere of bursting pressure. The alloy was completely liquid at 275° Fah. and solid at 254° F.,* when examined in the crucible. The heat was raised as slowly as possible, so as to permit the full effect of the temperature indicated by the thermometer; the observations recorded are as follows:—

Thermometer in Steam.		Therm. on top of boiler.	Pressure.	REMARKS.
Therm.	Scale.			
Fah.°	Fah.°	Fah.°	Atmos.	
256	58		2.2	Plate ¼th of an inch. Metal stands fused in the holes of the brass disk covering the fusible plate.
260		254		Steam issues in a very small stream through chinks between the fused metal and an unmelted part within.
270	58	262	2.7	Steam issues as before; no clear passage through the plate. Steam kept for a long time at this temperature. Six minutes elapsed in raising temperature 4½ degrees.
292		279	4.0	Plate gave way, affording a free passage to steam.
258				A second plate of the same composition and thickness, put in place; fluid metal stands in the holes of the cap.
267	83		2.6	Metal which has oozed out remains in a fluid state upon the sliding plate of the apparatus.
299	93		4.5	Plate gives way, torn in a thin part.

The thermometer on top of the boiler dipped into the mercury in a small cistern, made by inclosing a space on the top of the boiler, with clay; so that the top of the boiler formed the bottom of the cistern. The first plate having failed to give way until the temperature within the boiler was twenty-four degrees above that at which the alloy, of which it had originally been composed, had been fluid, was examined with great care. The plate had decidedly given way to pressure, and not by fusion; it had lost its metallic lustre at the side where it was torn; yielded readily to the nail, which scraped off small particles. A piece of the plate being cut off and laid upon the top of the boiler, remained solid, though the portion which had oozed out, was perfectly fluid, near the same spot. The same remarks apply, generally, to the second plate. They afford a solution of the perplexing circumstances, which had occurred throughout these experiments, and which had led to so many trials to discover their cause.

The portions of the metal which oozed out from these two plates had their fusing points taken, by gradually raising their temperature in a bath of oil, while the alloy rested on a small shelf of copper, wholly immersed in the oil. The first portions of fluid metal which had oozed from both the first and second plates, melted at betwen 221 and 223 degrees, Fah., being solid at the lower, and perfectly fluid at the higher, of these two temperatures. The

* This alloy had no stationary point in passing from the liquid to the solid state; but some internal change in the solid at about 206°, produced a rise and stationary point at 208°.

second portion which oozed out from the first plate, fused at between 230° and 233°, Fah., and a portion of that from the second plate was fluid at about 235½° Fah. The parts which were left, of the first plate, were a soft solid, at 299¼, fluid at one edge, at 312°, and entirely fluid at 345°.

The portions left, of the second plate, lost their cohesion, and could be broken by pounding, into small particles or grains, at 300¼°; and the whole was fluid at 356° Fah. A comparison of these results appears in the annexed table.

	First ooze.	Second ooze.	Residuum.	Entire plate before experiment.
	Fluid.	Fluid.	Fluid.	Fluid.
First plate, - -	223°	233°	312 *a* 345	254 *a* 275
Second plate, - -	223	235½ *a* 241½	356	

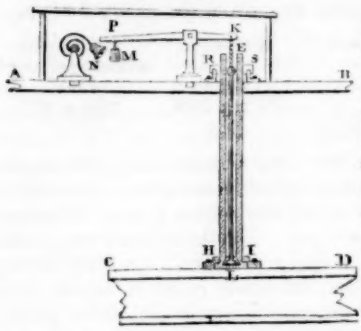
To pursue this subject further, by the clue thus obtained, only freeing the different oozes from accidental admixture, a small iron cylinder was made, closed at one end, and perforated near the closed end with a number of minute holes, not larger than the stem of a common pin. Into the cylinder was fitted, nearly tight, an iron piston, with a rod, to apply pressure. An alloy having been made and introduced into the cylinder, the whole could be heated in an oil bath to any desired temperature; and pressure being applied to the piston, the liquid parts would ooze out, through the small apertures near the end of the tube. The first alloy experimented upon was the same in composition with that just referred to; being composed of eight of bismuth, eight of lead, and seven of tin, by weight. This alloy was fluid at 254¼° Fah. At a temperature of 229°, some drops of fluid metal were forced out by pressure, and at about 239½° other portions were forced out. Both melted at 227° Fah. The portion left was a soft solid at 276¾° Fah.; fluid at 290½°. The alloy of one atom of lead, one of tin, and one of bismuth, is fluid at 273½° Fah., and that of one atom of lead, one of tin, and two of bismuth, at 219° Fah.

These experiments, the committee deem conclusive in regard to the use of fusible plates in the ordinary way, and they conceive that substituting fusible plugs of greater thickness, say half an inch, as has been directed by a recent ordinance in France, would not serve as a remedy to the defect thus exposed. The true remedy is to be sought in inclosing the fusible metal in a case, in which it shall not be exposed to the pressure of the steam, but only to its heating effect: the more fluid parts of the metal will then not be exposed to be forced out of the mass; and the whole will become fluid as if exposed to heat in a crucible. With this view of the subject, trial was made of an apparatus described by Professor A. D. Bache, in the Journal of the Franklin Institute, for October, 1832, under the title of an "alarm to be applied to the interior flues of steam-boilers."* This apparatus is obviously as applicable to a common boiler as to one with interior flues; the following description of it is given in the journal.

"A tube of iron, or copper," according to the material of the boiler, "closed "at the lower end, passes through the top of the boiler, its closed end reaching "the flue to which it is attached." "This tube, it will be observed, affords a "ready access to the flue, to ascertain its temperature, without any restraint "from packing." "A mass of fusible metal placed at the bottom of the tube," "will become fluid very nearly as soon as the flue takes the temperature of "fusion of the alloy." "To show when the metal at the bottom of the tube "becomes fluid, a stem is attached with a cord and weight," "or with a lever "and weight." "The weight and longer arm of the lever, descending, may be

* This paper was published in 1832, and the experiments of the Committee were made in 1833-4.

"made to ring a bell, or, by appropriate attachments, to turn a cock, permit-"ting just enough steam to issue to give the alarm, and then to be closed at "once. A projection on the lower end of the rod prevents it from being "drawn from the metal until this latter is fused, and by widening the lower "part of the tube, making it slightly tapering, the metal is kept from being "drawn out by the rod."



In the annexed figure "AB is a section through the top of the boiler; CD, a corresponding section of its flue, EH represents a tube closed at the lower end, which is attached to the upper side of the flue. The mode of attachment by a projection on the tube and a ring screwed to the flue, is shown in the figure, as also the stuffing box, RS, through which the upper end of the tube passes. The lower part HI, of the tube, is made tapering, to retain the fusible metal. KL is the stem, the lower part being inclosed by the fusible metal, the upper part attached by a chain to a lever KP. The weight M, draws the rod KL upwards, and on the fusion the alloy HI, carries the lever below the bell N, which, being attached to a spring, rings an alarm."

The form of this apparatus, which was subjected to trial by the committee, was essentially the same with that described. One of the tubes in which the thermometers were ordinarily placed, was used to contain the fusible metal, and as giving the more severe test, the short one entering only into the steam, was selected. For the convenience of removing the metal, it was placed in a metallic case, fitting loosely into the iron tube, and having a wire attached, by which it could be drawn out of the tube. This certainly diminished the sensibility of the apparatus, particularly, as the case was quite as thick as the inclosing tube, and as there was a small space between its convex surface and that of the tube; it was required, however, for the convenience of the experiments.

The results of the several trials are contained in the following table. The temperature was registered by the adjoining thermometer dipping into the water of the boiler, and already often referred to; it was raised as rapidly as possible in all the experiments except the first. The first four trials were made on an occasion specially devoted to this purpose, the last two were made incidentally when upon another subject.

Number of Trial.	Temperature. Fah°.	REMARKS.
1	268	Stem rises. No particular attention paid to raising the temperature rapidly.
2	270	Stem rises. Steam raised rapidly.
3		Metal drawn out and suffered to cool, re-deposited cold in tube. Steam at 258°, and raised to 274° in 2½ minutes.
	274	Stem rises.
4		Metal drawn out and cooled. Steam at 250°, when metal was replaced. Steam raised to 274° in 3 minutes.
	274	Stem rises.
	252	Metal had not become solid again. Steam let off rapidly.
5	270	Melted below this temperature.
6	256	Stem rises. Metal remains a soft solid, so that the stem can be drawn out, until 240°.

A fact noticed during the experiments on fusible alloys was again verified in these experiments; namely, that the mixtures of metals require a considerable time to change their state of solidity or of fluidity, so that in the former case they may be heated above the true temperature of fluidity, and in the latter case they may be cooled much below this temperature, without solidifying. The alloy used in these experiments, appears to have put the apparatus very fully upon its trial in this respect, and the experiments were performed so rapidly as to give a further severe test. On the occasion devoted to the trials when the steam was not urged up with its greatest rapidity, the stem was drawn out at 268°, when more rapidly at 270°, and with the fire at its maximum intensity, when the water was raised in temperature 24° in three minutes, the stem was drawn out at 274°. In other experiments it gave way at 256°. The range is 18° Fah., corresponding at ten atmospheres, to less than two atmospheres, under the test of very severe comparisons. There appears no reason to doubt, that when tested by no more rigid modes than practice would furnish, this apparatus would not only apply as an alarm to prevent undue heating of the parts of the boiler, but as a manageable, and useful check, in ordinary cases, upon the safety valve.

Conclusions.

The conclusions deduced from the foregoing experiments, on metallic alloys, may be thus stated.

1st. The impurities of common lead, tin, and bismuth, are usually not such as to affect materially the fusing points of their alloys.

2d. When mixed in equivalent proportions, tin and lead formed alloys, not presenting the characters of distinct chemical compounds, in definite proportions. The alloys between the range of one equivalent of tin, to one of lead, and one equivalent of tin to six of lead, varied considerably in the interval between the temperature of commencing to lose fluidity, and that at which a thermometer, immersed in the solidifying metal, became stationary. These different alloys produced nearly the same stationary temperature in a thermometer plunged into the solidifying metal.

3d. Fusible metal plates covered by a perforated metallic disk, and placed upon a steam-boiler, show signs of fluidity at the disk, before the steam has attained the temperature of fusion of the alloy of which the plate is composed. This fluid metal oozes through the perforations in the disk, and the plate thus loses much of its substance before finally giving vent to the steam.

4th. The under parts of the plate are not kept from fusion by a protecting film of oxide there formed.

5th. The thickness of the plate is not important, provided only that it is sufficiently strong to resist the pressure of the steam at temperatures below its point of fusion.

6th. The temperature at which the plates are cast, and the rate of cooling of the cast metal, do not affect the temperature at which the plates give vent to steam.

7th. The effect stated in conclusion third, is explained by the nature of the alloys used, which are formed of portions of different fluidities; the more fluid parts, are forced out by the pressure of the steam, leaving the less fusible. These latter in general are burst, not melted.

8th. By pressure in a receptacle provided with small openings, this effect of separating the differently fluid portions of an alloy, may be imitated.

9th. Fusible alloys, used to indicate the temperature of any part of a steam

boiler, should not be exposed to the pressure of the steam; at least not in such a way that the separation of the differently fusible constituents of the alloys may be effected.

Fusing Points of Alloys applicable to Steam Boilers.

The committee next proceed to give the results of their trials to determine metallic alloys proper to be applied to steam-boilers. This problem admits, of course, of a great variety of solutions. The metals used were limited to tin, lead, and bismuth; but still different mixtures of these may be made which will give alloys of the same fusing point. The property which was most desirable in these alloys was a small range of temperature in changing from the liquid to the solid state. This property, it will be seen, is difficult to attain, and the less fusible alloys of the first table, as well as the more fusible ones of the third, do not possess it. For the higher temperatures, alloys of lead and tin are applicable, and the question is reduced to an examination of the fusing points of different mixtures. The greater proportions of lead might be inferred to give the higher fusing points, and the less proportions the lower ones. Beginning with the alloy of equal weights of tin and lead, the following table gives fusing points between 355° and 503° Fah. The stationary points were taken as already described; all the alloys in the table, except the first, were hard before the stationary point occurred, and therefore this point indicated, in these cases, some internal change in the solid, and did not correspond to the passage from the liquid to the solid state. This seems not to have occurred to Mr. Parke, who speaks of having taken this point as corresponding to that of congelation. It should be observed, however, that his table of alloys shows a variety in the fusing points, which is incompatible with the observations of the committee, supposing the stationary point to have been taken in each case as the fusing point.

The alloys passing gradually from the fluid to the solid state, an attempt was made to seize the more remarkable points, as referred to in the table; but these can only be considered as approximately determined. Direct experiments were, in most cases, made upon the temperature at which the metal refused to allow a metallic stem to be withdrawn. This was the case when the metal, from the state of a soft solid, began to acquire hardness.

TABLE I. *Alloys solidifying between* 486° *and* 355° *Fah.*

Eight parts of Tin to Lead.	Begins to lose fluidity.	Loses fluidity.	Stem draws out.	Falls to.	Stationary.	Eight parts of Tin to Lead.	Begins to lose fluidity.	Loses fluidity.	Stem draws out.	Falls to.	Stationary.	REMARKS.
8	393°	355°			355°	20	492	446	416*	351½	354	* 415°, with temperature rising.
10	430½	375½		354	355	23	521	480	466	352†	353½	† Hard solid, at 426°.
12	445	393	380	352	354	26	529	503	486	‡	353	‡ Hard at 437°.
16	475	439	405	352	354							

The next object was to diminish the relative proportion of lead, so as to determine the most fusible alloy of the two metals. The results obtained will be seen in the following table. The lead was the same in each case; namely, eight parts by weight.

Eight parts of Lead with Tin.	Liquid metal begins to thicken.	Stationary Temperature.	REMARKS.
Parts.	Fah.°	Fah.°	
8	364½*	352†	* Began above this point. † In these three cases the alloy congeals in thin plates, at the surface, and is a sandy solid below, at the sides. A liquid, with solid portions, at stationary temperature.
		353†	
		353½†	
9	368½	351	
10		354*	* Hardens in round masses, which, at the stationary point, are surrounded by a liquid.
	366½	352½*	
		352½*	
11		353¼	
12		353	
16		352	

The table of alloys by Parke, before referred to, gives a considerable variation in the melting points of the alloys in the above table. He makes the stationary point of the alloy of eight to eight, 372° Fah.; that of eight lead and ten tin, 352°; that of eight lead to twelve tin, 336°; this latter being the most fusible of the alloys of lead and tin. That the alloy, in equal parts, has not a fusing point varying much from that just given, the committee were able to determine from various specimens of metal. With pure lead and grain tin, they found, for eight lead and nine tin, nearly the same as the foregoing, the stationary point to be, in different experiments, 355¾°, 356°, and 355½°. With one specimen of common lead the stationary point of an alloy of equal parts of lead and tin was 356° Fah. This lead melted at 606°, and the tin at 442½°. The committee have no greater reason to suspect the accuracy of their other results. In all these cases the stationary point occurs when the metal begins to solidify.

It appears, then, by the foregoing table, that very little change is effected in the fusing point of the alloy of equal parts of tin and lead, by increasing the quantity of the more fusible metal. A curious coincidence is shown between the stationary point of these alloys and of those in which the lead is increased. The two intervals, which are best determined in the table, between the temperature at which fluidity begins to be lost, and that at which the metal becomes solid, are seventeen and fourteen degrees. When the lead becomes considerable in quantity, the passage from the fluid to the solid state is by such minute mechanical changes, as to extend through a long series of temperatures. This is even more especially the case when bismuth also enters largely into the alloy; instructive examples of which occur in the following table.

Lead.	Tin.	Bismuth.		
20,	8,	8,	352°	Fused metal begins to lose fluidity.
			307	Soft solid, penetrable.
			279	Stationary point.
22,	8,	8,	358	Fused metal begins to thicken.
			280⅜	Stationary.
40,	8,	8,	466½	Begins to thicken.
			368⅓	Is a soft solid.
			337⅜	Hard solid.
			280¼	Stationary point.
44,	8,	8,	474¾	Begins to thicken.
			429¾	Loses fluidity; is a soft solid.
			388¾	Hard solid.
			280½	Stationary.
48,	8,	8,	481	Thickens.
			440	Loses fluidity.
			280⅓	Stationary.

From perfect solidity to the greatest degree of fluidity of which the alloy was capable, required in the case of the first alloy given above, about seventy degrees of temperature: and between the temperature at which a solid could pierce the alloy, and the stationary temperature, was eight degrees. When the quantity of lead was doubled, the first interval was nearly one hundred and thirty degrees; and the interval between the temperatures of solidity and that at which the alloy could be penetrated easily, was about twenty degrees.

These facts show that in using fusible alloys, those should be preferred which contain the smallest quantities of lead: a similar reason would lead to the preference of those containing the smallest proportions of bismuth.

Tin is nearly liquid at the stationary temperature; hardens by plates or small masses, and becomes entirely solid at this same temperature.

Experiments were made to ascertain what quantity of bismuth could be added to tin without destroying the property just described. To one hundred parts by weight, of tin, one part, five parts and ten parts of bismuth, respectively, were added. The first alloy melted at 439¾°, and had the general characters of tin in hardening; the second melted at 428°, and had these characters impaired; the third had no stationary temperature above four hundred degrees, and lost its fluidity by slow degrees.

As it was thus shown that alloys of tin and bismuth presented no peculiar advantages, the alloys for temperatures below 355°, Fah., were sought by combining the least quantity of bismuth which would give any requisite temperature with one of the alloys of the table on page 37. For this purpose the alloy of equal parts of tin and lead was selected as having appropriate characters in its solidification, and melting at nearly as low a temperature as any of the others in the table. It does not, of course, follow, that this alloy when combined with a given quantity of bismuth, will produce as low a fusing point as some other would; a question which, if it were worth deciding, experiment would determine. A few trials on this head were made by the committee.

The following table gives the proportions of bismuth, which, added to an alloy of eight parts of tin and eight of lead, will give the temperatures of the stationary points of an immersed thermometer between 355° and 326°. With the alloy which terminates this table, the stationary temperature near the fusing point disappears, and another form of table is required for description.

TABLE II. *Alloys of Tin, Lead, and Bismuth, melting between* 355° *and* 326° *Fah.*

Eight parts, by weight, of Tin, and eight of Lead.						
Bismuth.	Begins to lose fluidity.	Stationary point.	Bismuth.	Begins to lose fluidity.	Stationary point.	REMARKS.
0.0	393°	355°	1.0	362°	339¾°	All these alloys are liquid with solid portions, when the thermometer becomes stationary.
0.2	387	351	1.4	347	335	
0.4	375	349	1.8	343	331	
0.6	369	345¼	2.2	331	326*	* Slow, not stationary.
0.8		342½				

The stationary temperature having disappeared with the increase of bismuth, the points attempted to be ascertained were these; the temperature at which the metal began to lose fluidity; that at which it ceased to be a liquid, as indicated by the surface not returning to a level when indented; that at which the solid ceased to be penetrable to a small rod by moderate pressure; and when it became hard. As these temperatures present nothing as definite as the stationary temperature, they are, of course, only approximate. A few trials made on the withdrawal of a metallic stem from the alloy, showed that the temperature at which this ceased to be possible was, for the alloys in the following table, between the temperature at which the metal lost its fluidity, and that at which it could not be penetrated by moderate pressure.

TABLE III. *Alloys losing fluidity between* 313° *and* 246° *Fah.*

Eight parts, by weight, of Tin, and eight of Lead.									
Bismuth.	Begins to lose fluidity.	Begins to solidify.	Solid, not easily penetrated.	Hard, solid.	Bismuth.	Begins to lose fluidity.	Begins to solidify.	Solid, not easily penetrated.	Hard, solid.
2.6	326	313	307	301	5.4	296½	280½	270½	264½*
3.0	321	313		297	6.2	294½	269	261†	246
3.4	316	309	301	295½	7.0	288½	257	252‡	238
3.8	311	306	298½	289½	7.6	283½	253	242§	234
4.6	301	291		271½	8.0	272	246	232‖	226

* Stationary at 205°.
‡ Stem drew out at 254°.
‖ Stem drew out at 235°.
† Stem drew out at 264°.
§ Stem drew out at 245°.

The fusing points of the metals used in the foregoing alloys were, of the tin, 442° Fah., of the bismuth, 506°, of the lead, 612°.

VI. To repeat the experiments of Klaproth, relating to the conversion of water into steam, by highly heated metal.

It being now well understood that an increase of temperature in a metallic surface may diminish the amount of vaporization of a fluid placed upon it, the object of the following experiments was to study the phenomena attending the vaporization of water by iron and copper, under different circumstances.

1st. To ascertain the temperature, at which a given small quantity of water will be vaporized in the least time, by copper, with different states of surface.

2d. To ascertain the same point for iron, in similar circumstances.

3d. To extend these deductions to the effect of introducing different quantities of water into copper or iron vessels, varying in thickness, in character of surface, and heated by different sources, to various temperatures.

A number of bowls, of these different metals, of as nearly the same figure as could be obtained, and of different thicknesses, were provided. The bowls were portions of spheres, of nearly three inches radius, and were eight in number, three being of copper and five of iron; four of these latter were of wrought, and one of cast iron. For applying heat to the bowls, a cylindrical vessel containing oil, and another containing tin, were provided; the former was about nine inches in diameter, and four high, and the latter six and a half inches in diameter and four high. These vessels were heated by Mitchell's* alcohol lamp, or in the very high temperatures, by a charcoal furnace. The bowls were furnished with handles, which projecting, overlapped the edges of the cylinders serving as baths for the oil and tin, and were thus kept in place.

The thermometers used in the experiments, were carefully compared at the boiling point of water, and melting point of pure tin.

The experiments first to be detailed, refer to the vaporization of drops of water in copper bowls of different states of surface, from the smooth polish to the roughness of oxidation.

Vaporization of Drops of Water by Copper.

1. The bowl, No. VII. of copper, seven-hundredths of an inch thick, was polished, but not very highly, and then placed in the tin bath while fluid; the tin, on solidifying, kept the bowl in its place. The thermometer was placed in a small cylinder of thin sheet iron, containing mercury, the cylinder being as near the cup as possible. As the experiments progressed, the surface of the bowl became, of course, more and more tarnished; and after the two series of results recorded below were obtained, a third showed a marked effect from the oxidation, by the increased vaporization. One hundred and twenty drops, nearly, from the tube used, made up one-eighth of a fluid ounce; the weight of one drop was, therefore, about .47 of a grain.

* A very convenient alcohol lamp, with a draught through the wick, and a separation between the alcohol reservoir and the wick.—The invention of Dr. J. K. Mitchell.

Smooth surface. Copper bowl .07 inch thick.				
Descending Series.*			Ascending Series.	
Temp.	Drops on Centre.		Drops on Centre.	
Fah.°	Time.	Remarks.	Time.	Remarks.
	Secs.		Secs.	
315.3	5	On a polished part.		
317.3	3	On less polished.	$3\frac{1}{2}$	
319.3	> 2			
321.4	3		3	
			$2\frac{1}{2}$	
323.4			$2\frac{1}{2}$	
325.4			2	
327.5	2		$1\frac{3}{4}$	
329.5	2		$1\frac{1}{2}$	
331.5			2	
333.6	$2\frac{1}{2}$	Not repelled.	2	
335.6			> 2	
337.6				On a rough place, $1\frac{1}{2}$ seconds.
339.7		Not repelled.		
341.7		A drop on side of bowl, 12 secs.		
343.8				
345.9				
348				
350	165	Repulsion perfect. Tempera. rising to 360°.		
352				

The temperature of maximum vaporization, under these circumstances, appears to have been between $327\frac{1}{2}°$ and $329\frac{1}{2}°$ Fah., the two series coinciding nearly in their indications; the repulsion is shown to have been perfect at 350°, the drop falling upon the centre assuming the usual rotary motion, and disappearing very slowly.

2. The surface of this same bowl was next highly polished with rotten stone

* In this and other tables, the series marked descending, are those obtained when the temperature was falling; the ascending series were obtained while the temperature of the bath was rising.

and oil, and a similar method of experimenting gave the following results, the same bath being used.

Polished Copper Surface.		
Descending Series.		
Temperature.	Drops on Centre.	
	Time in Secs.	Remarks.
445	210	Perfectly repelled.
370.5	177	Do.
331.6	157	Do.
318.3	25	Repulsion obviously lessened.
313.2	9	Repulsion not perfect.
300	4	
291.6	3½	
,,	3	
285.5	4	
284.5	4½	
279.4	5½	
275.4	6½	
271.3	5½	
267.2	6	
255	16½	

(*To be continued.*)

Reply to the Query in regard to the Coating of the Pipes forming the Condenser at the Philadelphia Gas Works.

TO THE COMMITTEE ON PUBLICATIONS.

Gentlemen,—Your correspondent, in his query proposed in the last number of this Journal, has fallen upon a disputed point of science; but I will endeavour to furnish the grounds for deciding his question, according to the conflicting authorities.

The object of the pipes, to which he refers, is to condense, in part, the moisture and other easily condensible matters, which come over with the heated gas from the retorts, previous to its entrance into the purifiers, where it circulates in contact with lime. This object is attained by a series of vertical

pipes, connected at the top, and passing at the bottom into large boxes, with vertical partitions, not extending quite to the bottom of each box. The gas passes through the pipes and their boxes in succession, circulating from one end to the other of the series, being thus exposed to the cooling action of the metal of the pipes and boxes. In the latter the condensed substances collect, and are removed by suitable openings.

Whatever means, then, will tend to allow the escape of heat from the metal of the condensers, will promote their efficiency. The air without, and the surrounding bodies, are supposed cooler than the gas passing through the pipes, which will be true, except in extraordinary cases.

The heat of the gas will be carried off more rapidly as the exterior surface of the condenser is kept cool. In this case, the surface will be cooled in two ways,—by contact of the air, and by radiation. The air adjacent to the pipes becoming heated, by contact with them, will rise, giving place to cool air; this will, in turn, be heated, and rise, continuing the cooling operation.

Besides this, heat is radiated from the surface of the pipes, which, if not restored by radiation from surrounding bodies, serves also to cool them.

It has been established by careful experiments,* that the nature of the surface of contact of air and a body, the extent of surface remaining the same, has no influence on the cooling produced by the contact of a gas. Therefore, whether the paint upon the condensing pipes was of white lead, or lamp black, or any other material, there would be no difference in the cooling effect by contact.

As to the cooling effect of radiation, there is not such certainty. Doctor Stark, of Edinburgh, has endeavoured to show that black substances radiate better than white ones. He has made a few experiments, directly applicable to the subject, which, as far as they go, warrant this conclusion. If it be correct, the condensers should have been painted black. When the sun is not directly shining upon them, they would radiate better than white. When the sun is upon them, the absorption of heat being greater than it would be if the pipes were white, the cooling effect will be considerably diminished. As, however, the condenser is attached to the north wall of a building which is higher than the pipes, the sun will never reach it, except early in the morning, and late in the afternoon, even at midsummer.

On the contrary, your Journal for November contains an extensive series of experiments, by Prof. A. D. Bache, in which colour does not appear to influence the radiation or absorption of heat unaccompanied by light. The experiments were made† by a similar method to that used by Doct. Stark. One of them, which is to the point now before us, was as follows: A small cylinder, filled with warm water, and allowed to cool in the air, required 817 seconds to cool through forty degrees of Fahrenheit's scale, when coated smoothly with India ink; and 846 seconds when coated with white lead, laid on with gum. The ratio of the times of cooling is 1 to 1.03, or within what is stated to be the limit of error in the method of experimenting. It might very well happen that a small difference in the thickness of the two coatings of white and black paint, would produce more effect than this difference of the radiating powers of white lead and lamp black, supposing them to be as just deduced.

It is now well known that the laws which apply to heat, accompanied by

* Petit and Dulong, Ann. de Chim. et de Phys., 1817.

† Inquiry into the alleged Influence of Colour on the Radiation of non-luminous Heat, &c., p. 291, vol. xvi. of this Journal.

light, do not apply to non-luminous heat; hence, there is no discrepancy between the experiments just adverted to, and those of Franklin, in which is shown the greater effect of black cloth than of white, in absorbing the heat from the sun's rays. According to the conclusions from the experiments of Prof. Bache, *the condensers are correctly coated.* For when the sun is not shining upon the pipes, the white paint radiates heat as well as black would; and when the sun does shine upon them, the white absorbs less of the heat accompanying the light, than black would do. The coating of white paint should be thick to derive the full effect from its radiating power, which increases with the thickness up to a certain point, above which the diminution is very slow. U.

On the rights of Patentees, with a letter of Mr. Jefferson on that subject, first published in Niles' Register, and afterwards in the 2d vol. of the Emporium of Arts, new series, p. 446.

We have had repeated, we might almost say perpetual, occasion to remark upon the claims of patentees to what they denominate the *application* of a machine, or instrument, to certain purposes for which it has not been previously used. We accord with Mr. Jefferson, most fully, in many of his observations on that subject, although we do not go with him to the full extent on certain points, as we believe that there are cases where a machine already used in one manufacture, may be beneficially employed in another; and that a patent may be sustained for so employing it; but in this case the patent must not be for the machine, but for "an improvement in the art" to which it is applied. Thus, for example, if a person can introduce into the silk manufacture any apparatus by which a large proportion of the expense attending the ordinary process is saved, he has *improved the art of manufacturing silk*, although he may not have invented any new machinery, but merely have applied that already known so as to produce decided improvements. If substances had heretofore been pulverized in a mortar by repeated blows of a pestle, and some one was to discover that the same effect might be produced in half the time by a rubbing motion of the same instrument, he would be well entitled to a patent for an improvement in the art of using the pestle and mortar, or rather in the art of pulverizing hard substances by means of the pestle and mortar, but to the instruments themselves he must not make any claim.

There is a very frequent want of discrimination in the applicants for patents as respects the head under which they make their claim to invention or discovery. The objects patentable under the law are "any new or useful art,—machine,—manufacture,—or composition of matter;—or any new and useful improvement in any art,—machine,—manufacture,—or composition of matter, &c." Now all these are different things, and they ought to be designated accordingly in an application for a patent. If velvet had never been made, the making of it would be "a new manufacture" and might be patented as such; the mode of making it, however, must be described, and this might consist entirely in the use of well known machinery.

The letter of Mr. Jefferson was elicited by queries respecting the patent of Oliver Evans, at that time under litigation; but with that question our republication of it has nothing to do. Individually, we are of opinion that Oliver Evans was very hardly dealt by, although we admit that the course adopted by him was in some instances unwise; but of one thing there can be no doubt, namely, that he found the grain mills of this country in a very imperfect

state, and that he introduced and perfected those improvements which have rendered them models for the whole civilized world, and that for all he did in this way, his expenditures were greater than his receipts. [*Editor.*

Letter of Mr. Jefferson.

MONTICELLO, Aug. 13th, 1813.

Your letter of August 3d, asking information on the subject of Mr. Oliver Evan's exclusive right to the use of what he calls his Elevators, Conveyers and Hopperboys, has been duly received. My wish to see new inventions encouraged, and old ones brought again into useful notice, has made me regret the circumstances which have followed the expiration of his first patent. I did not expect the retrospection which has been given to the reviving law; for although the second proviso seemed not so clear as it ought to have been, yet it appeared susceptible of a just construction; and the retrospective one being contrary to natural right, it was understood to be a rule of law, that where the words of a statute admit of two constructions, the one just and the other unjust, the former is to be given them. The first proviso takes care of those who had lawfully used Evans' improvements under the first patent; the second was meant for those who had lawfully erected and used them after that patent expired, declaring they "should not be liable to damages therefor." These words may indeed be restrained to uses already past; but as there is parity of reason for those to come, there should be parity of law. Every man should be protected in his lawful acts, and be certain that no ex post facto law shall punish or endamage him for them. But he is endamaged if forbidden to use a machine lawfully erected at considerable expense, unless he will pay a new and unexpected price for it. The proviso says: that he who erected and used lawfully shall not be liable to pay damages; but if the proviso had been omitted would not the law, construed by natural equity, have said the same thing? In truth both provisos are useless. And shall useless provisos, inserted pro majori cautela, only authorize inferences against justice? The sentiment that ex post facto laws are against natural rights is so strong in the United States, that few, if any, of the State Constitutions have failed to proscribe them. The Federal constitution indeed interdicts them in criminal cases only; but they are equally unjust in civil as in criminal cases: and the omission of a caution which would have been right, does not justify the doing what is wrong; nor ought it to be presumed, that the legislature meant to use a phrase in an unjustifiable sense, if by any rules of construction it can be even strained to what is just. The law books abound with similar instances of the care the judges take of the public integrity. Laws moreover abridging the natural rights of the citizen, should be restrained by rigorous constructions within their narrowest limits.

Your letter, however, points to a much broader question, whether what have received from Mr. Evans the new and the proper name of Elevators are of his invention: because, if they are not, his patent gives him no right to obstruct others in the use of what they possessed before. I assume it as a lemma, that it is the invention of the machine itself which is to give a patent right, and not the application of it to any particular purpose of which it is susceptible. If one person invents a knife convenient for pointing our pens, another cannot have a patent right for the same knife to point our pencils. A compass was invented for navigating the sea; another cannot have a patent right for using it to survey land. A machine for thrashing *wheat*

has been invented in Scotland; a second person cannot get a patent right for the same machine to thrash *oats;* a third *rye;* a fourth *peas;* a fifth *clover,* &c. A string of buckets is invented and used for raising water, ore, &c., can a second have a patent right to the same machine for raising wheat, a third oats, a fourth rye, a fifth peas, &c.? The question then whether such a string of buckets was invented first by Oliver Evans, is a mere question of fact in mathematical history. Now turning to such books only as I happen to possess, I find abundant proof that this simple machinery has been in use from time immemorial. Doctor Shaw, who visited Egypt and the Barbary coast in the years 1727—8, 9, in the margin of his map of Egypt, gives us the figure of what he calls a Persian wheel, which is a string of round cups, or buckets, hanging on a pully, over which they revolve, bringing up water from a well, and delivering it into a trough above. He found this used at Cairo, in a well 264 feet deep, which the inhabitants believe to have been a work of the patriarch Joseph. Shaw's Travels, 341, Oxford edition of 1738, in folio, and the Universal History, I, 416, speaking of the manner of watering the high lands in Egypt, says—"Formerly they made use of Archimedes' Screw, thence named the Egyptian Pump; but they now generally use Wheels (Wallowers) which carry a rope or chain of earthen pots, holding about 7 or 8 quarts a piece, and draw the water from the canals. There are besides, a vast number of wells in Egypt, from which the water is drawn in the same manner to water the gardens and fruit-trees; so that it is no exaggeration to say, that there are in Egypt above 200,000 oxen daily employed in this labour." Shaw's name of Persian wheel has been since given more particularly to a wheel with buckets, either fixed or suspended on pins at its periphery. Mortimer's Husbandry, 1, 18, Duhamel, V. Ferguson's Mechanics, plate 13. But his figure, and the verbal description of the Universal History, prove, that the string of buckets is meant under that name. His figure differs from Evans' construction in the circumstance of the buckets being round, and strung through their bottom on a chain; but it is the principle; to wit, a string of buckets, which constitutes the invention, not the form of the buckets, round, square, or hexagon; nor the manner of attaching them, nor the material of the connecting band, whether chain, rope or leather. Vitruvius, L. X. c. 9, describes this machinery as a windlass, on which is a chain descending to the water with vessels of copper attached to it; the windlass, being turned, the chain moving on it will raise the vessels, which, in passing over the windlass, will empty the water they have brought up into a reservoir: and Perault, in his edition of Vitruvius, Paris, 1784, folio, plates, 61, 62, gives us three forms of these water elevators, in one of which the buckets are square, as Mr. Evans' are. Bossut, Histoire des Mathematiques, I. 86, says, "The drum wheel, the wheel with buckets, and the *chapelets,* are hydraulic machines, which come to us from the ancients; but we are ignorant of the time when they began to be put into use." The *chapelets* are the revolving bands of buckets, which Shaw calls the Persian wheel, the moderns a chain pump, and Mr. Evans, elevators. The next of my books, in which I find these elevators, is Wolf's Cours de Mathematiques, I. 370, and plate 1, Paris, 1747—8vo. Here are two forms; in one of them the buckets are square, attached to two chains, passing over a cylinder or wallower at top, and under another at bottom, by which they are made to revolve. It is a nearly exact representation of Evans' elevators. But a more exact one is to be seen in Desaguliar's Experimental Philosophy, II. plate 34. In the Encyclopedie de Diderot et D'Alembert, 8vo. edition de Lausanne, 1st. vol of

plates, in the four subscribed "Hydraulique, noria," is one, where round earthen pots are tied by their collars, between two endless ropes, suspended on a revolving lanthern or wallower; this is said to have been used for raising ore out of a mine. In a book which I do not possess, "L'Architecture Hydraulique de Belidor, the II vol. of which is said [De La Lande's continuation of Montucla's Histoire des Mathematique's, III. 711] to contain a detail of all the pumps, ancient and modern, hydraulic machines, fountains, wells, &c. I have no doubt this Persian wheel, chain pump, chapelets, elevators, by whichever name you choose to call it, will be found in various forms. The last book I have to quote for it, is Prony's Architecture Hydraulique, I. advertisement VII. and secs. 648, 649, in the latter of which passages he observes, that the first idea which occurs for raising water is to lift it in a bucket by hand; when the water lies too deep to be reached by hand, the bucket is suspended by a chain and let down over a pully or windlass: if it be desired to raise a continued stream of water, the simplest means which offers itself to the mind is to attach to an endless chain or cord a number of pots or buckets, so disposed that the chain being suspended on a lanthern or wallower above, and plunged into water below, the buckets may descend and ascend alternately, filling themselves at bottom, and emptying at a certain height above, so as to give a constant stream.—Some years before the date of Mr. Evans' patent, a Mr. Martin of Caroline county, in this state, constructed a drill plough, in which he used the band of buckets for elevating the grain from the box, into the funnel which let them down into the furrows: he had bands with different sets of buckets, adapted to the size of peas, of turnip seed, &c. I have used this machine for sowing benni-seed also, and propose to have a band of buckets for drilling Indian corn, and another for wheat. Is it possible that in doing this I shall infringe Mr. Evans' patent? That I can be debarred of any use to which I might have applied my drill when I bought it, by a patent issued after I bought it?

These verbal descriptions applying so exactly to Mr. Evans' Elevators, and the drawings exhibited to the eye, flash conviction both on reason and the senses that there is nothing new in these elevators but their being strung together by a strap of leather. If this strap of leather be an invention entitling the inventor to a patent right, it can only extend to the strap, and the use of the string of buckets must remain free to be connected by chains, ropes, a strap of hempen girthing, or any other substance except leather; but indeed Mr. Martin had before used the strap of leather.

The screw of Archimedes is as ancient at least as the age of that mathematician, who died more than two thousand years ago. Diodorus Siculus speaks of it, lib. 1, page 21, and lib. 5, page 217, of Steven's edition of 1559, folio, and Vitruvius, X. 11. The cutting of its spiral worm into sections, for conveying flour or grain, seems to have been an invention of Mr. Evans, and to be a fair subject of a patent right, but it cannot take away from others the use of Archimedes' screw, with its perpetual spiral, for any purposes of which it is susceptible.

The Hopperboy is an useful machine, and as far as I know original.

It has been pretended by some (and in England especially) that inventors have a natural and exclusive right to their inventions; and not merely for their own lives, but inheritable to their heirs; and while it is a moot question, whether the origin of any kind of property is derived from nature at all, it would be singular to admit a natural and even an hereditary right to inventions. It is agreed by those who have seriously considered the sub-

ject, that no individual has, of natural right, a separate property in an acre of land; for instance, by an universal law, indeed, whatever, whether fixed or movable, belongs to all men equally and in common, is the property for the moment of him who occupies it; but when he relinquishes the occupation the property goes with it. Stable ownership is the gift of social law, and is given late in the progress of society: it would be curious then if an idea, the fugitive fermentation of an individual brain, could of natural right be claimed in exclusive and stable property. If nature has made any one thing less susceptible than all others of exclusive property, it is the action of the thinking power called an idea; which an individual may exclusively possess as long as he keeps it to himself, but the moment it is divulged, it forces itself into the possession of every one, and the receiver cannot dispossess himself of it. Its peculiar character too is that no one possesses the less because every other possesses the whole of it. He who receives an idea from me receives instruction himself without lessening mine; as he who lights his taper at mine receives light without darkening me. That ideas should freely spread from one to another over the globe for the moral and mutual instruction of man and improvement of his condition, seems to have been peculiarly and benevolently designed by nature when she made them, like fire, expansible over all space, without lessening their density in any point; and like the air in which we breathe, move, and have our physical being, incapable of confinement or exclusive appropriation. Inventions then cannot in nature be a subject of property. Society may give an exclusive right to the profits arising from them as an encouragement to men to pursue ideas which may produce utility. But this may or may not be done according to the will and convenience of the society, without claim or complaint from any body. Accordingly it is a fact, as far as I am informed, that England was, until we copied her, the only country on earth which ever, by a general law, gave a legal right to the exclusive use of an idea. In some other countries it is sometimes done in a great case and by a special and personal act; but generally speaking other nations have thought that these monopolies produce more embarrassment than advantage to society; and it may be observed that the nations which refuse monopolies of inventions are as fruitful as England in new and useful devices.

Considering the exclusive right to invention as given, not of natural right but for the benefit of society, I know well the difficulty of drawing a line between the things which are worth to the public the embarrassment of an exclusive patent and those which are not. As a member of the patent board for several years, while the law authorised a board to grant or refuse patents, I saw with what slow progress a system of general rules could be matured. Some however were established by that board. One of these was, that a machine of which we were possessed, might be applied by every man to any use of which it is susceptible, and that this right ought not to be taken from him and given to a monopolist, because he first, perhaps, had occasion so to apply it. Thus a screw for crushing plaster might be employed for crushing corn cobs; and a chain pump for raising water might be used for raising wheat—this being merely a change of application.—Another rule was, that a change of material, should not give title to a patent; as the making a plough share of cast rather than wrought iron; a comb of iron instead of horn or of ivory; or the connecting of buckets by a band

of leather rather than of hemp or iron. A third was, that a mere change of form, should give no right to a patent; as a high quartered shoe instead of a low one, a round hat instead of a three square, or a square bucket instead of a round one; but for this rule, all the changes of fashion in dress, would have been under the tax of patentees. These were among the rules which the uniform decisions of the board had already established: and under each of them Mr. Evans' patent would have been refused. 1st, because it was a mere change of application of the chain pump from raising water, to raise wheat. 2d, Because the using a leathern instead of a hempen band, was a mere change of material: and 3dly, square buckets instead of round, are only a change of form; and the ancient forms too, appear to have been indifferently square or round. But there were still abundance of cases which could not be brought under rule until they should have presented themselves under all their aspects; and these investigations occupying more time of the members of the board, than they could spare from higher duties, the whole was turned over to the judiciary, to be matured in a system under which every one might know when his actions were safe and lawful. Instead of refusing a patent in the first instance, as the board was authorized to do, the patent now issues of course subject to be declared void on such principles as should be established by the courts of law. This business however is but little analogous to their course of reading, since we might in vain turn over all the lubberly volumes of the law, to find a single ray which would lighten the path of the mechanic or mathematician; it is more within the information of a board of academical professors, and a previous refusal of a patent would better guard our citizens against harrassment by law suits. But England had given it to her judges, and the usual predominancy of her example carried it to ours.

It happened that I had myself a mill built in the interval between Mr. Evan's first and second patents. I was living in Washington, and left the construction of the mill entirely to the mill-wright. I did not even know he had erected elevators, conveyors and hopperboys, until I learnt it by an application, from Mr. Evans' agent for the patent price. Although I had no idea he had a right to it by law (for no judicial decision had then been given) yet I did not hesitate to remit to Mr. Evans the old and moderate patent price, which was what he then asked, from a wish to encourage even the useful revival of ancient inventions. But I then expressed my opinion of the law, in a letter either to Mr. Evans or to his agent.

I have thus, sir, at your request, given you the facts and ideas which occur to me on the subject. I have done it without reserve, although I have not the pleasure of knowing you personally. In thus frankly committing myself to you, I trust you will feel it as a point of honour and candour to make no use of my letter, which might bring disquietude on myself;* and particularly I should be unwilling to be brought into any difference with Mr. Evans, whom, however, I believe to be too reasonable to take offence at an honest difference of opinion. I esteem him much, and sincerely wish him wealth and honour. I deem him a valuable citizen of uncommon ingenuity and usefulness; and had I not esteemed still more the establishment of sound principles, I should now have been silent. If any of the matter I have offered can promote that object, I have no objection to its being so used. If it offers nothing new, it will of course not be used at all.

*It is proper to observe, that though the author did not at the time of writing this letter, contemplate its publication, yet his permission has since been obtained.

I have gone with some minuteness into the mathematical history of the elevator, because it belongs to a branch of science, in which, as I have before observed, it is not incumbent on lawyers to be learned; and it is possible, therefore, that some of the proofs I have quoted, may have escaped on their former arguments.

On the law of the subject I should not have touched, because more familiar to those who have already discussed it, but I wished to state my own view of it merely in justification of myself; my name and approbation being subscribed to the act. With these explanations accept the assurances of my respect.

THOMAS JEFFERSON.

FOR THE JOURNAL OF THE FRANKLIN INSTITUTE.

Description of the Patent Spark Arrester, for Locomotive Engines using Wood. *By* A. C. JONES, *Engineer.*

Fig 1.

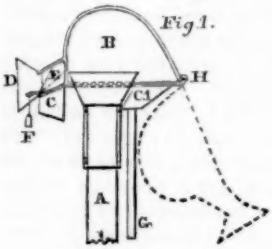
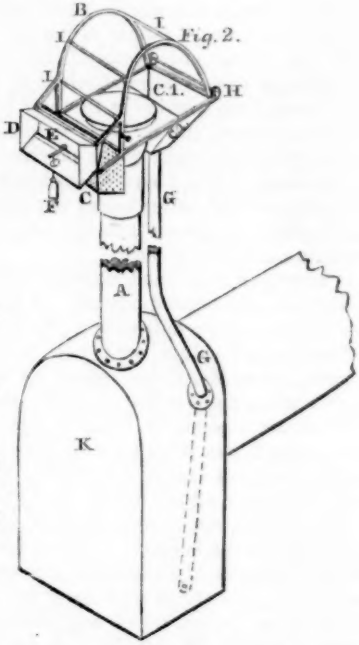


Fig. 2.



A, the smoke pipe.

B, cap.

C C, receptacle for sparks, or cinders.

D, funnel.

E, valve or shutter; the dotted lines show it open.

F, counterbalance to shutter.

G, pipe to convey the sparks to the bottom of smoke chamber.

H, hinges to admit of the cap being turned over, as shown in fig. 1.

I, cross bars.

K, smoke chamber.

L, pin to turn the cap.

The advantages of the above represented cap over others that have been tried, are as follows: By making the front open, cold air is forced in by the speed of the engine; this, mixing with the smoke and vapour, cools it, and thereby prevents the gauze from being burnt; (on one engine the gauze has been in use nine months, and remains good at the present time.) The sparks and cinders being conveyed by the pipe, G, to the bottom of the smoke chamber, out of the influence of the flues, are there consumed; there is consequently, no trouble in cleaning the cap on the journey. By making the cap with hinge joints, the clogging of the gauze by lamp-black is prevented, it not being necessary to turn the cap over the pipe, until the train is ready to start. The facility with which the cap can be taken off, for the purpose of

cleaning, or to repair, is of some importance. In running backwards, the movable shutter closes the opening in front, and the sparks pass into the perforated box, and are consumed.

When the cap is in use, it is held down by a catch, which is released when the cap is to be turned off, as represented by the dotted lines, fig. 1.

The wire gauze is secured in its place by being clamped between the ribs of iron, and the frame.

After the experience of more than nine months with this plan of spark arrester, on three different constructions of locomotive engines, (and all with the same success,) I do not hesitate to say that the draught is not injured by the use of the cap.

Certificates.

Mr. A. C. Jones' spark arrester has been in use on the Portsmouth and Roanoke Rail-road, for about two months. It answers the purpose for which it was intended, and which its name indicates, better than any thing of the kind which I have seen. Since the use of Mr. Jones' machine, passengers are not at all annoyed by sparks, and a very slight covering is sufficient protection to the most combustible material (cotton in bales) which is transported on the road.

WALTER GWYNN, *Civil Engineer.*

I fully concur with Mr. Gwynn in recommending the invention of Mr. Jones, as the best which I have seen, and least likely to affect unfavourably the draught of the furnace of the engine. ARTHUR EMERSON,
President of the Portsmouth and Roanoke Rail-road Co.
Portsmouth, October 17, 1835.

Communications relating to the spark arrester, (post paid,) directed to Thomas C. Garrison, or A. C. Jones, Portsmouth, Va., will be promptly attended to.

Civil Engineering.

Report in relation to a proposed rail-road from the River Ohio to the Tide Waters of the Carolinas.

The committee to whom was referred the subject of a rail-road from the Valley of the Ohio river to the maritime coast of the Carolinas and Georgia, having in a general manner considered its practicability and advantages, beg leave to submit the following

REPORT.

The states which border on the Ohio, or are watered by its great tributary streams, are western or tramontane Pennsylvania and Virginia, Ohio, Indiana, Illinois, Kentucky, and Tennessee; nearly through the centre of which that river flows, almost parallel with the sea coast of the old southern states. From the seven states above mentioned, there are highways of communication with the ocean in but two directions—north-east, and south-west. The former, consisting of several distinct lines of river, canal, macadamized and rail-road communication, reaches the Atlantic ocean between

the west end of Long Island Sound and the mouth of the Chesapeake Bay—from New York to Norfolk—a distance, on a straight line, of 300 miles: The latter communicates with the Gulf of Mexico by the delta of the Mississippi. Between these two points of marine connection with the interior, is a coast nearly 3000 miles in extent, constituting the sea-board of southern Virginia, North and South Carolina, Georgia, Florida, Alabama, and Mississippi, with which the states in the Valley of the Ohio have no direct communication, even by means of a good post-road, so that the mail to the northern frontier of Georgia and the Carolinas, not three hundred miles distant from the banks of the Ohio, in a straight line, is actually sent by Washington City, on a route nearly four times as long. With that part of the southern coast which lies west of the peninsula of Florida, the Ohio states have ready intercourse, by the Mississippi river; but with the region east of that peninsula, they are destitute of all adequate means of commercial and social connection. Here then is a great *desideratum*, which can be supplied in no other manner than by the contemplated RAIL-ROAD.

Starting, perhaps from more than one point on the Ohio river, in the state of Kentucky, this road should stretch nearly south; and branching, when it enters the Carolinas and Georgia, to reach their tide-waters at several different places. Taking Cincinnati as a city intermediate between Maysville and Louisville, and Charleston as intermediate between Wilmington, in North Carolina, and Augusta, in Georgia, the road might be said, more especially, to connect Cincinnati and Charleston, and may for convenience in this report, take its length and designation from those cities. Starting from the former, or rather, from the opposite bank of the Ohio river, in Newport or Covington, it would traverse the state of Kentucky to the Cumberland Gap, near the south-western angle of the state of Virginia, then cross the state of Tennessee, and, ascending the valley of the French Broad, in North Carolina, arrive at Greenville, or some other point, in South Carolina, beyond the Allegheny mountains, whence it may pass down to Augusta, in Georgia, by one branch, and by another more immediately to Charleston, in the direction of Columbia. In traversing North Carolina, it might with facility, the surface of the country permitting, be connected by a lateral road, with the projected Cape Fear and Yadkin rail-way, which passing through Fayetteville, is to terminate at Beaty's Ford, on the Catawba river.

The distance between Cincinnati and Charleston, on a straight line, is about 500, which would probably require a road of 700 miles. South Carolina, however, has already made a railway, 135 miles in length, to Hamburgh, on the Savannah river, opposite Augusta, nearly in the direction of Cincinnati; and the contemplated rail-road to Paris, in Bourbon county, Kentucky, exactly in the course of Charleston, (for the construction of which there are, in the opinion of your committee, a great many weighty reasons of a local nature,) would have a length of about 90 miles, thus leaving but 475 miles to complete this new and most important communication, between the interior and the sea-board of the south.

The middle of this main trunk would be intersected by the projected rail-road from Richmond, Virginia, *via* Lynchburg, to Knoxville, in east Tennessee, by which the Old Dominion would acquire a new channel of intercourse with her daughter Kentucky; and also with several of the states formed out of the North-Western Territory, which was once her property,—travelling from the West to southern Virginia, being thus restored to the route which it took in the infancy of our settlements.

By an extension west, to Nashville, of the Richmond, Lynchburg and

Knoxville road, the whole of central and northern Tennessee would be enabled, with great facility, to communicate with the Carolinas and Georgia, by means of the southern extremity, and with the state of Ohio, by means of the northern extremity of the great highway under consideration.

From the maritime terminations, and the lateral branches of this extended trunk, let us turn our attention to the northern or continental connections which it would establish.

These would extend, both east and west, from Cincinnati, for several hundred miles, and through every intervening northern point. First, the Ohio river would connect it with western Virginia and western Pennsylvania —embracing the valleys of the Great Kenhawa, Monongahela and Allegheny rivers: Second, the Ohio and Erie canal, from Portsmouth to Cleveland, already finished; the Miami and Maumee canal, in progress from Cincinnati to Lake Erie, uniting at Fort Wayne with the Erie and Wabash canal of Indiana; and the Mad-river and Sandusky rail-road, from Dayton to the Lake, the execution of which has commenced, would connect it with the entire chain of northern lakes, from the falls of Niagara to the Straits of Mackinac, and even Green Bay, on the western shore of Lake Michigan, including the eastern border of Wisconsin Territory, north or maritime Illinois and Indiana, the whole of Michigan Territory, a part of Upper Canada, and the centre and northern declivity of Ohio: Third, the Wabash and Erie canal just mentioned, and the rail road from Lawrenceburg, at the mouth of the Great Miami, to Indianapolis, already begun, would carry its advantages into the depths of Indiana: Fourth, the Ohio river from Cincinnati to the Mississippi would connect it, beneficially, with south and west Illinois, Missouri, and the immense extent of unsettled territory watered by the upper Mississippi and Missouri rivers. Thus the proposed main trunk, from Cincinnati to Charleston, would resemble an immense horizontal tree extending its roots through, or into, ten states, and a vast expanse of uninhabited territory, in the northern interior of the Union, while its branches would wind through half as many populous states on the southern sea-board.

The extent of this inland communication from north to south, through the centre of the United States, would comprehend at least 15° of latitude, and could only be compared with that established by the Mississippi river. It would not indeed be limited by the continent, for, as many important islands of the West Indies are contiguous to South Carolina, *they* would, in fact, be comprehended in the new facilities of intercourse that would be established between the south and north, and should, therefore, be taken into the estimate.

Of the physical practicability of constructing the main trunk of the proposed rail-way, across the states of Kentucky, Tennessee, and North Carolina, your committee see no reason to entertain a doubt. It is true, that it must traverse many of the branches of the Cumberland and Tennessee rivers, and scale the southern extremities of the Allegheny mountains. One of the branches, however, of the latter river, the French Broad, as we have already seen, originating on the slopes of the Blue Ridge, the most southern of the mountain chains, runs to the north, traversing the western angle of North Carolina, to unite with the Tennessee, thus opening a pass through a part of the mountains, and inviting to the enterprize. Of the height of the remaining mountains, your committee cannot speak with confidence, but believe it to be less than that of the Alleghenies, where they are traversed by the rail-road and canals from Philadelphia to Pittsburg. However this may be, no decision of the question of physical practicability

can be made, but by competent engineers, on an actual examination of the route.

The question of expense can of course only be settled by the same means. Assuming that the projected rail-road from the Ohio river, opposite Cincinnati, to Paris, in Bourbon county, Kentucky, will, from the considerations limited to the region of country concerned, be most certainly executed, and referring to the actual completion of the rail-road from Charleston to Augusta, the intervening section would not, as we have seen, exceed 475 miles, which, at the high price of 12,500 dollars per mile, would amount to 6,000,000 of dollars; a sum not greater than is about to be expended by a company of capitalists, in the construction of a rail-way within the state of New York, to run nearly parallel with her grand canal, and connect the same waters with the same city.

It may be said, however, that the central part of the Cincinnati and Charleston road would run through a country but thinly inhabited, and furnishing little aid, either in the construction of the road or in swelling the amount of transportation upon it. But why *is* it so sparsely peopled? Manifestly, in part, because of all portions of our common country, it is the most inaccessible and the most destitute of facilities for the exportation of its iron, salt, coal, tar, turpentine, and other natural productions. To wait, therefore, for a denser population, as a condition for commencing a great work of internal improvement, which only can augment that density, would be to wait for the development of an effect, before resorting to the only cause that can produce it. Let the road be executed, and an instantaneous impulse will be given to improvement in that region. If, however, it were too sterile for such a result to occur, no argument against the project could arise from that fact, for the undertaking is necessary to the reciprocal exchange of the production of the states penetrated by its extremities, in which respect it would be similar to the Philadelphia and Pittsburg route, which, in a part of its course, passes over uninhabited mountains, and still facilitates an immense trade between the east and west.

Thus it is not necessary that the whole line of an artificial way should lie through a cultivated and populous country, nor need we look to the inhabitants along this or any other projected rail-road or canal, for the means of its construction. These will be furnished by the capitalists of any and every part of the country, or even by those of Europe, the moment the enterprize is authorized by the states through which it is to be carried on, and the probabilities of a profitable investment are rendered manifest. In the opinion of your committee, the states of Kentucky, Tennessee, and the Carolinas, might, in their sovereign capacity, execute this work, and make it a rich and lasting source of revenue; and, they have as little doubt, that the incorporated joint stock companies would at once be able to command the requisite capital.

Your committee are of opinion, that the strongest motives exist for the immediate execution of this great work. At least half the people of the Union, comprehending, in whole or in part, in East Florida, Georgia, South Carolina, North Carolina, Virginia, Pennsylvania, Tennessee, Ohio, Michigan, Indiana, Illinois and Missouri, are interested in its completion, as they would instantly participate in its advantages; and, as your committee believe, need only to investigate the subject, to be at once aroused to efficient action.

Would it pass, like the New York canal, or the projected rail-road from Augusta, in Georgia, to Memphis, in Tennessee, nearly from east to west, and consequently combine regions which have similar climates, and identical

productions, its value would be far less. But, as we have seen, stretching boldly from north to south, and, with the present and future public works of the states between the Ohio river and the lakes, establishing a high road of communication through nearly all the climates and varieties of soil, productions, and people of the United States, it would forever stand alone and conspicuous among the public works of the Union, both in the kind and amount of commercial and social intercourse which it would promote.

The sustenance and manufactures of the corn states, from Kentucky to Michigan, would instantly pass along it to the southern consumer, of the region from Cape Florida to the Chesapeake Bay, avoiding all the delays, commissions, dangers of the river, and dangers and damages of a tropical sea voyage which belong to the Mississippi and Gulf route; and even much of the produce that might be designed for coasting or foreign exportation, would reach the sea-ports of South Carolina and Georgia, by the same channel, instead of going to New Orleans or New York. On the other hand, the tropical productions of the north east of Cuba, and of East Florida—their spices, sugar, oranges, lemons, and figs;—and the indigo, rice and cotton of Georgia and Carolina would, by the same direct route, penetrate, in a few days, the interior of the continent, and spread among the consumers, even to the shores of Lake Superior.

Some of your committee, indeed, incline to the belief, that the same channel would, at no distant time, become an inlet for many of the productions and manufactures of foreign countries; for commerce, as far as possible, should be based upon a *direct* exchange of productions and commodities. Thus the shipping merchants of Charleston and Savannah, might barter their cotton in Europe for manufactures required by the people of the states in the Valley of the Ohio, and exchange the same for their sustenance; the whole operation, both continental and marine, being performed without the instrumentality of any other money than that employed in defraying the expenses of transportation.

Of the *amount* of the business that would, at length, be conducted on this national high-way, the committee scarcely dare to speak. To them it appears of a magnitude, which they fear the meeting and the community at the *present time* would regard as extravagant and incredible. By the existing population of the portions of country, even now connected with the work, there would be a great amount of traveling and transportation; but the extent to which it would augment the population of the zone of country through which it would pass; the impulse to agriculture it would impart; the manufacturing establishments it would set up, and the lateral turnpikes, rail roads and canals it would suggest, to new districts of country, from the western slopes of the Allegheny mountains to the banks of the Mississippi, from the sea to the lakes, would make it the parent of a great system of central internal improvement, and enable it to augment the amount of its articles of transportation to an indefinite degree. These immense pecuniary benefits, accruing to millions of people, should, of themselves, prompt those who are interested to an immediate attention to the work; but there are other and nobler considerations, which should not be overlooked.

No public work could contribute more powerfully to our national defence. Establishing a direct and rapid communication, between the northern and southern frontiers of the United States, separated, unlike the eastern and western, from the dominions of foreign nations by narrow sheets of water only, it would afford facilities for the transportation of troops, munitions of war, and military sustenance, from the centre to the borders, or even from one frontier to the other, with unexampled rapidity; thus favour-

ing a concentration, requisite to national defence in time of war, which could not otherwise be effected; and which would present a new triumph of civilization over barbarism, by making civil public works, an efficient substitute for standing armies and powerful navies, which exhaust the resources and endanger the liberties of a nation.

But the most interesting and affecting consequence that would flow from the execution of this enterprise, would be the social and political.

What is now the amount of personal intercourse between the millions of American fellow citizens of North Carolina, South Carolina, and Georgia, on the one hand, and Kentucky, Ohio, Indiana, and Illinois, on the other? Do they not live and die in ignorance of each other; and, perhaps, with wrong opinions and prejudices, which the intercourse of a few years would annihilate forever? Should this work be executed, the personal communication between the north and south would instantly become unprecedented in the United States. Louisville and Augusta would be brought into social intercourse; Cincinnati and Charleston be neighbours; and parties of pleasure start from the banks of the Savannah for those of the Ohio river. The people of the two great valleys would, in the summer, meet in the intervening mountain region of North Carolina and Tennessee, one of the most delightful climates in the United States; exchange their opinions, compare their sentiments, and blend their feelings—the north and the south would, in fact, shake hands with each other, yield up their social and political hostility, pledge themselves to common national interests, and part as friends and brethren.

Finally, the immense summer throng of visitors which annually go up to the north, along the sea-board, would be made still greater, and turning westwardly through the states of Virginia, Maryland, Pennsylvania, and New York, spread over the northern centre of the United States, to the shores of the lakes and upper Mississippi; concentrating on their return in the Valley of the Ohio; having seen what they now never see, and made acquaintance with what at present is unknown to them, the very heart of the Republic. On the other hand, the people of the north would, in autumn and winter, pour down upon the temperate plains of the south, in turn, studying their political, civil, and literary institutions, participating in their warm hospitality, catching a glow of southern feeling, gratifying their curiosity, and return enlarged in their patriotism and enriched in their knowledge of our common country. Thus this traveling, alone, would, at no distant day, reimburse the expenditures by which it might be created, while it would unite with the ties of business, in confining with a new girdle, states which are now but loosely connected, and thereby contribute powerfully to the perpetuity and happiness of the Union.

DANL. DRAKE,
T. W. BAKEWELL,
JNO. S. WILLIAMS,
} Committee.

Cincinnati, Aug. 15, 1833.

Physical Science.

FOR THE JOURNAL OF THE FRANKLIN INSTITUTE.

Historical notice of a Hypothesis to explain the greater quantity of rain which falls at the surface of the ground than above it. By A. D. BACHE, *Prof. of Nat. Philos. and Chem. Univ. Penn.*

In the report of Prof. Phillips, of King's College, London, on the relative

quantities of rain collected at different heights, the following hypothesis is offered, as deduced from his observations.

"So remarkable and continued an accordance between the co-efficients fixed by observation and those derived by two methods from a very simple view of the condition of the air as to heat and moisture, appears to me decisive of the question as to the general cause of the variation of the quantity of diminution of rain at any one height above the ground. It has already been shown how strictly the observations warrant the conclusion that the ratio of diminution at different heights is constant throughout the whole year. It is therefore rather as a matter of very probable inference than a plausible speculation that I offer the hypothesis, that the whole difference in the quantity of rain, at different heights above the surface of the neighbouring ground, is caused by the continued augmentation of each drop of rain from the commencement to the end of its descent, as it traverses successively the humid strata of air at a temperature so much lower than that of the surrounding medium, as to cause the deposition of moisture upon its surface." [Third Report of British Assoc. page 410.]

The fact that a less quantity of rain is received by a rain guage upon an elevation than upon the subjacent ground, was proved about the year 1766 by the experiments of Dr. Heberden, Lord Cavendish, and others. The hypothesis now advanced by Prof. Phillips, was suggested about 1771 as an explanation of their curious results by Dr. Franklin, and he is not the less entitled to the credit of originating it that after fully considering the subject he cautiously concluded, that the then state of knowledge of it was hardly ripe for making *any hypothesis*. "I think we want more and a greater variety of experiments in different circumstances, to enable us to form a thoroughly satisfactory hypothesis." His remarks contained in a letter to Dr. Percival, who has also written on the subject, were first published in the Manchester Memoirs for 1784. The following is Dr. Franklin's view of the matter:

"I suppose it will be generally allowed, on a little consideration of the subject, that scarce any drop of water was, when it began to fall from the clouds, of a magnitude equal to that it has acquired, when it arrives at the earth; the same of the several pieces of hail; because they are often so large and so weighty, that we cannot conceive a possibility of their being suspended in the air, and remaining at rest there, for any time, how small soever; nor do we conceive any means of forming them so large, before they set out to fall. It seems then, that each beginning drop, and particle of hail, receives continued addition in its progress downwards. This may be in several ways; by the union of numbers in their course, so that what was at first only descending mist becomes a shower; or by each particle, in its descent through air that contains a great quantity of dissolved water, striking against, attaching to itself and carrying down with it such particles of that dissolved water, as happen to be in its way; or attracting to itself such as do not lie directly in its course by its different state, with regard either to common or electric fire, or by all these causes united.

"In the first case, by the uniting of numbers, larger drops might be made, but the quantity falling in the same place would be the same at all heights; unless, as you mention, the whole should be contracted in falling, the lines described by all the drops converging, so that what set out to fall from a cloud of many thousand acres, should reach the earth in perhaps a third of that extent, of which I somewhat doubt. In the other cases we have two experiments.

"1. A dry glass bottle filled with very cold water, in a warm day, will pre-

sently collect from the seemingly dry air that surrounds it a quantity of water, that shall cover its surface and run down its sides, which perhaps is done by the power wherewith the cold water attracts the fluid, common fire, that had been united with the dissolved water in the air, and drawing the fire through the glass into itself, leaves the water on the outside.

"2. An electrified body left in a room for some time will be more covered with dust than other bodies in the same room not electrified, which dust seems to be attracted from the circumambient air.

"Now we know that the rain, even in our hottest days, comes from a very cold region. Its falling sometimes in the form of ice, shows this clearly; and perhaps even the rain is snow or ice when it first moves downwards, though thawed in falling: and we know that the drops of rain are often electrified: but those causes of addition to each drop of water, or piece of hail, one would think could not long continue to produce the same effect; since the air, through which the drops fall, must soon be stripped of its previously dissolved water, so as to be no longer capable of augmenting them. Indeed very heavy showers, of either, are never of long continuance, but moderate rains often continue so long as to puzzle this hypothesis; so that upon the whole, I think, as I intimated before, that we are yet hardly ripe for making one."

In investigating a complex subject of this kind, the experimenter not unfrequently proceeds as if it were entirely new, and to this cause I attribute the fact that Prof. Phillips was not aware that he had been anticipated in his hypothesis. The demonstration of the hypothesis, if it is considered conclusive is sufficient distinction, and belongs to a more advanced state of science than that of which the eighteenth century could boast. The credit of *originating it* we should abandon.

December, 1835.

Notice of Tide Observations in the United States. By a Correspondent.

TO THE COMMITTEE ON PUBLICATIONS.

In the American Almanac for the year 1836, of which there is a very favourable and just notice in the January number of the Journal of the Institute, occurs the following paragraph, from the pen of the editor of the astronomical department.

"It may be proper to remark that notwithstanding the three corrections abovementioned, the computed time of high water frequently in calm weather, differs considerably, perhaps half an hour, from the computed. Indeed, until recently, astronomers seem to have been contented with the knowledge that the flow and ebb of the sea were caused by the attraction of the sun and moon, and to have taken little pains to increase their acquaintance with these curious and interesting phenomena. But as, within a short time, much attention has been turned to the subject, and many competent persons in Europe have undertaken to make careful observations for a series of years, on every tide, we are induced to hope that the causes of some of the anomalies, not only in the time of high water, but also in the rise of the tide, may be discovered, and their effects predicted. It is a source of deep regret that these European savans will not, probably, find any co-labourer in this country. Possessed, as we are, of an immense coast, and the second commercial nation on earth, it would seem that an accurate knowledge of the causes of the tides would be, unto us, of the highest importance; but there is too much reason to fear we shall do no more to advance this great work, than we have done for astronomy in general, viz: to declare ourselves the most enlightened people ever in existence, to fold our arms, and continue to be indebted to the noble nation from which we are descended, for their Nautical Almanac, without which, hardly an American vessel would go to sea."

Now, here is a severe charge by an American editor, which ought only to have been made, if made at all in such a work, after full inquiry into the

facts of the case. "There is too much reason to fear that we shall do no more to advance this great work, than we have done for astronomy in general." Whatever reproach must lie at our door for the neglect of astronomy in general, we are blameless in regard to the branch relating particularly to the tides, at least as far as observation goes. Inquiry would have shown that an extensive series of tide observations were made along the line of our Atlantic coast, in June last, under the direction of the commander-in-chief of the United States' army, and by request made to the Executive of the United States, by a branch of the government of Great Britain. We ought, perhaps, before this, to have had in some one of our journals at least a general account of these observations. The execution of the task without any accompanying boast will serve, however, to illustrate the disinterestedness of the motive which prompted the undertaking, while the nature of the undertaking itself vouches for some share of scientific zeal.

An acknowledgment for these promised observations was made by the Rev. Mr. Whewell, at the meeting of the British Association for the Advancement of Science, in August last. D.

FOR THE JOURNAL OF THE FRANKLIN INSTITUTE.

Review of a "Geological Report of an Examination, made in 1834, *of the Elevated Country between the Missouri and Red rivers. By G. W. Featherstonhaugh, U. S. Geologist.* Published by order of both Houses of Congress. Washington: Printed by Gales & Seaton.* 1835."

In the present age of utilitarianism, the value of scientific knowledge is very generally and very properly appreciated, by the benefits which result from its practical application to the ordinary pursuits of life; and there is no science which, when tried by this test, ranks higher in the scale of utility than geology. Its existence is, indeed, of recent date, but it has already afforded more real and useful information respecting the structure of the planet we inhabit, and the position of its mineral treasures, than had been acquired in all the previous ages of the existence of the human race. It was, therefore, to be expected, that both governments and individuals would be eager to avail themselves of the facilities presented by this science, and to apply them to the investigation of those subterranean sources of wealth, which are so influential in the promotion of national prosperity. The spirit of enterprise, so characteristic of the American people, was promptly directed to so attractive an object; and different geological surveys have been made, the results of which have been in the highest degree beneficial to the interests of the country. The state of North Carolina may be said to have taken the lead in this career of utility; and the zeal of Massachusetts in the same cause has been rendered eminently conspicuous by the full and able report of her geologist, Prof. Hitchcock. These examples have been followed by the general government, and those of the states of New Jersey, Virginia, Maryland, and Tennessee. Different gentlemen have been employed by these authorities to make geological investigations of states, or districts, and several of their reports have been made and published; some portion, therefore, of information on this important subject, has been very generally diffused. It must not, however, be concealed

* Whence this title is derived, or by whom conferred, we are uninformed. Geological surveys have been made in England, and in France, but we have never met with the title of "Geologist of England," or "Geologist of France."

that there is some danger of our being led into error by these attempts to circulate knowledge; for, unless the persons selected to make these surveys are eminently qualified for the task, and discharge it with judgment and caution, erroneous opinions may be promulgated, and results proportionably disastrous will be the consequence; for, as the statements thus made are brought forward under the stamp of a certain degree of personal and official authority, they may, perhaps, frequently obtain more credit than is due to their intrinsic merit.

I have been led to these considerations by the perusal of the report lately made to the general government by Mr. Featherstonhaugh, the gentleman employed by it to make geological researches in some of its territories, upon which I purpose to offer some brief remarks. In the copy of the instructions of the Topographical Bureau, prefixed by Mr. F. to his report, we find that he was directed "personally to inspect the mineralogical and geological character of the highlands and water sheds, in the elevated country lying between the Missouri and Red rivers, where the public lands are situated," and to state whatever geological information he might possess, which might aid in developing the resources of said country." Under the authority, probably, of the requisition contained in the latter part of these instructions, or, as he himself states, to make his report as permanently instructive as possible, and *transparent to the intelligence of all*, (see p. 6 of the report,) he has thought proper to commence it with a geological essay, which occupies about one-half of the work. The propriety, in any case, of thus swelling out a report, is very questionable, for it distracts the attention from the main object of the work, and, unless it is exceedingly well executed, it does not communicate either instruction or information to the parties whom it is intended to profit. Professor Hitchcock had indeed set the example, in his report on the geology of Massachusetts; but it may be doubted whether, by so doing, he has not sacrificed what ought to have been the main object of his undertaking, viz: the communication to the great body of the people of his state, in language so free from technicalities as to be generally intelligible, a plain statement of its resources and mineral wealth. This error, however, if it be one, is, in a great measure, compensated for by the character of the report itself, which may vie with any geological work extant, in the accuracy of its scientific details, and the fidelity of their topical application. The same cannot, I think, be said of the essay of the U. S. Geologist, which is not only somewhat unsatisfactory in its matter, but also very generally expressed in language, which, so far from being *transparent to the intelligence* of the uninitiated, must, in a great measure, be unintelligible, even to those who are more intimately acquainted with the subject.

It would be an ungrateful and invidious task to point out all the passages in this work which seem liable to these objections; I must, however, in justification of the opinions I have ventured to express, offer one or two instances. I would therefore ask what meaning is to be elicited from the following passage: "We are not to regard the radial space as a mere vacancy, where igneous action is exerted, but as a field where it acts upon matter in states and conditions of which, perhaps, the scientific chemist has but a faint conception; for we are taught, upon the authority of eminent philosophers, that the density of the interior is much greater than that of the crust. It will be perceived by this mode of reasoning, that the force of such a radial space, acting under such conditions, could not but produce results equivalent to the grandeur of its power, and which might justify geologists in referring the origin and actual state of what is called the crust

of the earth, to its direct and indirect action." (p. 8 of the report.) I believe that, on the principle of taking "ignotum omne pro magnifico,"* the grandiloquent obscurity of these sentences, which are taken at random, and to which parallels are to be found in almost every page, has not a little contributed to obtain for this report, amongst certain persons, the celebrity which it seems to have acquired. To compensate, however, for the mysticism of the above quotation, in the next page the author favours us with a truism, which cannot fail to be particularly edifying to the European geologists, who, he says, are calling "upon us of this western continent for geological investigations;" for he seems actually to have discovered, that "if, at any period in the history of our planet, the mineral matter constituting the dry land has been distributed beneath the waters of the sea, the planet would then have been entirely covered by water."—(p. 9 of the report.) It was, perhaps, hardly necessary to have gone so far as Arkansas, to ascertain this fact. Mr. F. seems, also, to have discovered a new method of determining heights, to which he, on two or three occasions, refers; for instance, at p 59, he says, "On extricating myself from this arid plain, I reached a ridge with an elevation of about 70°." It is to be hoped that, in his next work, he will favour us with the scale upon which his heights are graduated, for, as he does not refer to any horizontal base, and could not, in the situation which he is describing, command the horizon of the sea, there is at present some ambiguity in his expression.

Some explanation seems to be required, likewise, of his novel mode of estimating the measure of dimensions, for the problem, to find the "superficial cubic contents" (p. 52 of the report) of a body, is one with which we are not familiar.

But I will not dwell on these inaccuracies of language, as it is of more importance to examine the correctness of such of the statements of our geologist, as are more particularly connected with the objects of his tour; for, on the supposition that they may be received as authority, an error in them would be attended with more injurious results.

It may, perhaps, be considered, that he has traveled somewhat out of his record in communicating to us his opinions respecting the gold mines of this country; but as they are delivered with an air of confidence, likely to impose conviction of their truth on persons unacquainted with this subject, they may not be undeserving of remark; for all exaggerated estimates of the value, or probable duration, of these mines, have a tendency to lead to fruitless expenditure, and consequent disappointment.

Mr. Featherstonhaugh states that "Gold mining is yet in its infancy in the United States; in truth, preparations for systematic mining are only now making."—(note to p. 9 of the report.) Persons most conversant with the subject are, however, I believe, unanimous in the opinion, that it has at least reached its full maturity, if, indeed, it be not already past its prime. The only description of gold mines as yet worked with any profit in this country, are those termed deposit mines; and if we look at the present condition of the gold districts in North Carolina and Georgia, where this description of mine has been most extensively found, we shall see that this opinion is not without foundation. In all the counties of North Carolina, south of the mountains, the mines have been worked, and nearly exhausted; in Burke and Rutherford counties, particularly in the latter, where the discovery of mines is of most recent date, there still remain deposites, which, if worked with no greater force than that at present employed upon them, may last four or five years longer; and the portion of the Cherokee

* Tacitus vit. Agric.

territory situated in the state of North Carolina, where it has been ascertained that gold may be found, and in which the mines have been but partially worked, is of very limited extent, and its mines are not considered, by persons who have examined them, to be so rich as those in that part of the territory lying in Georgia. The deposit mines of North Carolina will, therefore, be of finite duration, and the quantity of their produce may be expected to sink gradually under the decline which they have manifested for the last two years.

The deposit mines in Georgia have, probably, been richer than those in any other part of what is called "the gold country;" but the minute division of property in that portion of the state where they were most abundant, occasioned by the injurious system of lottery, under which it was parceled out amongst the good citizens of the state, and the high degree of excitement into which the public mind had been brought on the subject, occasioned extensive operations to be commenced simultaneously in all parts of the district, as soon as the right of property had been determined.

The extent of each gold lot was small, and the proprietors were eager to reap the golden harvest, by the prospect of which their expectations had been so strongly excited; the consequence of this was, that many of the mines, and some of them the best in the district, were worked out during the first year after the drawing of the lottery; but, so great was the number of adventurers who entered into this business, entirely ignorant of the first principles of mining, that it may be confidently affirmed that more money was lost than made, during that year, in the gold mines of Georgia.

This bad success greatly diminished the number of miners in the succeeding year, but, as those who persevered had acquired more judgment, and conducted their operations with greater skill, their labours were rewarded with better success, and the quantity of gold procured from the mines, during each of the two last years, has been as great as in the first year, and the profits of those engaged in the business more considerable. But this cannot last, and I have been recently informed by an intelligent gentleman, in whose opinion I have full confidence, that nearly all the deposit mines will certainly be exhausted in less than two years more. Some few persons, indeed, who, by their speculations during the drawing of the lottery, obtained possession of several lots, may have reserved localities on which operations may be continued for a longer period, and some of the mines in what are called the older counties, such as that of Mr. Richardson, in Habersham, being of larger extent, may have a proportionably longer duration; the beds of the Chestatee and Etowah rivers may likewise yield gold for a long time, but the annual supply from all these sources cannot be expected to be nearly so great as that which has been afforded during each of the last three years by the mines of this state. I have but little personal knowledge of the mines of Virginia, but by what I have learnt from the accounts of others, the deposit mines of that state have never been either numerous, or very productive. As, therefore, deposit mines are, from the very nature of their formation, and from the ease with which they may be worked, of short duration, in a country where the mining districts are of limited extent, and where the industry of a large population will always be directed to so alluring a pursuit, the hopes of this country for a continued supply of gold from its own resources, must ultimately rest on the vein mines, and it must be to these that Mr. F. alludes, when he says, "preparations for systematic mining are only now making." Now, I am sorry to differ with him in opinion, but I have seen many mines, of various

metals, and in different parts of the world, and I never saw one in which more skill and science were evinced in the construction of the works for the reduction of the ore, or in the underground works of the mine, than in the gold vein mine near Charlotte, in Mecklenberg county, N. C., owned by a company in New York, and conducted for nearly three years by the Chevalier Rivafinoli, who was himself a scientific miner, and had under him officers, both natives and foreigners, of competent ability; yet the undertaking entirely failed, not from any want of system, or skill, but because the mine gave out, or became too poor to pay the cost of working. I could mention many other mines, both in North Carolina and Georgia, which at first gave great promise of success, and in which the works, though perhaps inferior to those at Charlotte, were constructed on principles recommended by European practice, but which have all failed from a similar cause. In consequence of these disappointments, vein mining for gold has been very generally abandoned, and I believe no other than the Capp's mine, near Charlotte, was in course of work at the close of 1834. As, during the last year, I have been less acquainted with the actual state of the mines than formerly, I do not know what may be the present prospects of the last mentioned mine, or whether any others have been opened in North Carolina, or Georgia; but the instances I have cited, sufficiently prove that the present low condition of vein mining in those states is rather owing to the poverty of the mines, and to their small extent in depth, than to the want of system, or industry, in their management. Mr. Featherstonhaugh says, "not one shaft has yet been sunk exceeding 160 feet;" a satisfactory reason to account for this is, that every mine, yet opened, has given out before it reached that depth. Several gold vein mines have likewise been discovered in Virginia, and the working of one in Fauquier county has been commenced by a company, which is proceeding with much spirit in the undertaking; it is to be hoped success will crown the efforts of its proprietors, but no reasonable conjecture can be formed as to their prospects, till they have reached the depth of from 100 to 150 feet.

These observations certainly militate against the conclusion, "that the progressive scale of production since 1824 warrants the most favourable anticipations for the future;" for, if they are correct, it may rather be expected that the produce of gold from the mines of this country has already reached its maximum, and is henceforward likely to decrease. According to a statement, which I saw a few days since, of the quantity received in the mint during the present year, 1835, it appears to be less than that received in 1834, by between twenty and thirty thousand pennyweights, and not to amount to more than one-fourth part of the three millions of dollars, predicted by Mr. F. as the produce of the year; and it must likewise be considered, that, in consequence of the advanced price given at the mint, under the new regulation of the value of gold, the proportion of the whole produce which now reaches that establishment, is likely to be greater than formerly.

In page 14 of the report, we find the following remark: "talcose slate" is a mineral formation, in which the auriferous veins of the United States are found, the veins in some parts of the country, passing through a field of talcose slate several miles in breadth, whilst in others they are sheathed only, as it were in the talcose slate, and pass through a field of elvan and granite rocks of various kinds." If by this assertion, it is intended to be implied that talcose slate is exclusively the repository of the gold veins in the United States, it is certainly at variance with general experience; that this formation is favourable

to the production of gold, and that veins of that metal are frequently found in it, will readily be admitted, the mines of Virginia and some of those in Georgia are thus situated, but nearly all those of North Carolina and most of those in Georgia are found in a very different rock: and no instance, I believe, of a gold vein in granite has ever presented itself in this or any other country; the small quantity of gold found in Cornwall has always been obtained from the formation, known in that country by the name of killas.

Our author appears to be a believer in the exploded doctrine, that the formation of metallic veins is attributable to the ejection of mineral matter in a state of igneous fusion from the interior of the earth; should the capitalists of Missouri be induced, by a confidence in "the reasonableness of the opinion that metallic veins have their origin from below," (p. 10) to enter with more spirit into the business of mining, it would undoubtedly be a benefit both to themselves and to their country; but should this be their only inducement, it may be feared, that they will be discouraged in the pursuit, when they discover that the most eminent geologists in this and other countries consider that such a mode of their formation is far from being satisfactorily established; if such however is the opinion of Mr. F. he certainly has a right to express it, but as it has been a controverted question, some reasons for such a belief, more conclusive than his arbitrary dictum, would perhaps have been desirable in a work intended to be "permanently instructive."

Mr. F. does indeed refer to some circumstances in a subsequent part of his work, which, he says, "seem to point to a projection of mineral and metallic matter from below:" but, if we examine these circumstances we shall not, I think, find in them, any thing like an argument to support this hypothesis. That the flat or horizontal veins which he met with in the lead mines of Missouri, are "lateral jets from the main lode," cannot be doubted; but the position of the metal at the bottom of the cavities or pockets which he describes, is most satisfactorily accounted for by the supposition that it has percolated, whilst in a state of fusion, through the soft matter of the red clay; for the admission, that it was brought into this situation by a projection from below, would be a contradiction of his own theory of their formation.

From various passages in the report, it is evident, that Mr. F. inclines to the opinion, that bituminous coal is a substance originating from mineral matter; this is another disputed point amongst geologists, and every one is at liberty to defend the side of the question which seems to himself most reasonable. It may however be observed, that the presence of "bituminous matter in beds of fetid limestone" has been satisfactorily accounted for on other grounds, and even admitting as fact the very questionable assertion, (p. 32) that the exclusive carboniferous country, in which coal is found to the west of the Mississippi, does not present a basin-like appearance, in which trees or plants could have been washed, or in which aquatic plants could have adequately grown, still it does not present any argument to disprove the opinion of those who attribute to coal a vegetable origin; for they generally suppose, that the vegetable growth, which produced the coal, was deposited on the spot, where it originally grew, and not that it has been washed into the situations where it is now found; and as the remains of vegetation distinguishable in coal beds, by no means indicate an exclusively aquatic growth, such a disposition might as easily have taken place on a level as on a basin-like surface.

Were I to instance all the glaring violations of philosophical principles and scientific language, which obtrude themselves upon our notice throughout this prefatory essay, I should trespass too largely on the pages of your

journal: I must therefore pass them by, and proceed to accompany our geologist on his tour, and as we journey on together, I hope he will allow me the privilege of making such observations, as may enable us duly to appreciate its "interesting results!"

It will be seen that he dashes at once "*in medias res*," and that, although he has presented the public with a map of unusual longitudinal dimensions, he leaves it to be inferred, from his own authority, that its geological delineations are correct, and does not offer any particular explanations of its contents. On his arrival in Missouri, his attention was necessarily directed to the lead mines, which form so prominent a feature in the mineralogical character of that country. These mines appear to lie unusually near the surface, and to be of such exuberant richness, that the main vein extends itself in lateral branches, or, as they are generally termed by miners, flat veins, in all directions, where the softness of the materials of the adjacent country, or natural fissures in the strata of the rocks, permit the formation of the metal. Such of these flat veins as lie nearest the surface, appear to have been broken into fragments, more or less minute, by some great convulsion occasioned probably by that modification of the power of volcanic agency, which so frequently displays itself in the production of earthquakes; a visitation to which the events of the year 1812 have shown this district to be liable; electrical action may likewise, as supposed by Mr. F. have contributed to the production of these effects.

These disruptions of the surface have exposed to view the contents of such of the upper veins, as from their situation were most affected by the shock, and, as a necessary consequence of such exposure of the mineral, adventurers have applied themselves to its extraction, by digging pits on the surface, and have thus brought the face of the country into the disorder described by Mr. F.; and which he attributes to ignorance of the geological structure of the country, and the commonest principles of mining. That such persons were not likely to be great proficients in the science of geology and oryctognosy must be allowed, but perhaps more information on these subjects would not have induced them to alter the mode of their proceedings; for they well knew, that the readiest mode of procuring the ore, was to them the most profitable; and as each individual had nothing more to do, than to dig a pit, and collect the metal it afforded; such a desultory method of working answered the purpose of supplying their immediate wants; and, as they were careless of consequences, they preferred it to entering into combinations with others, and commencing the more laborious and hazardous undertaking of deep mining. The same course has invariably been pursued, on the first discovery of surface mines in all parts of the world, till the right of property was established; in the earliest ages, the mines of Cornwall were thus worked, and, more lately, the gold mines of Georgia suffered from a similar cause, for it is exactly the mode in which the adventurers, or intruders as they were called, conducted their operations, till driven off by the guards of the State. It will be obvious to the intelligence of every scientific miner, that these superficial works, if in the vicinity of a main vein, will be productive of effects exceedingly injurious and embarrassing to any future attempts to work the mine in a more regular manner; and an immediate stop should be put to such proceedings if carried on upon the public lands; for the benefit of the individuals engaged in them, bears no proportion to the deterioration they occasion in the value of the property. The superficial indications of veins, situated as those above described, are necessarily numerous and easy to be understood; for as the gangue of the shatter-

ed veins is thrown out with the mineral, when rocks of a similar character are discovered on the surface in other places, it is good evidence of the proximity of a vein, in situations where the mineral may be concealed by the superincumbent soil. I should suppose, it must have been from such circumstances that Mr. F. has been enabled to determine, (p. 51) "that the mineral indications on the public lands were quite as encouraging as at the established mines" for he gives us no particular account of the means he took to ascertain the fact, indeed this brief assertion contains all the information, with which he favours us, respecting the mineralogical character of that portion of the public lands, which may be supposed to contain lead. It is much to be regretted that he did not consider it a part of his official duty to investigate more fully the character of the produce of the lead mines in Missouri, particularly in those places where shafts have been sunk to some depth; for he must have been aware that galena is very generally accompanied by sulphuret of silver, and he might have known, that the substance which forms the gangue of the mines he visited, is similar to that of the gangue of the celebrated mines of Clausthal, in the Hartz mountains in Hanover, which are richer in silver than any other mines in Europe. Such an enquiry would have been interesting both to scientific and practical men, and would have enabled the Government, and the country to form a more correct estimate of the value of the public lands in that state and the neighbouring territories. He does indeed mention in another part of his report (p. 61) "that he had never seen in any portion of the territory of Arkansas, the least indication of the precious metals, apart from a very small portion of silver contained in the sulphuret of lead;" but as he gives no account of any lead mines being worked in Arkansas, he must have formed his opinions on this subject, from the inspection of those fragments of sulphuret of lead, which he describes, as found on the surface, in furrows excavated by the rains; and if he could *see* in such specimens any trace of silver, he surely ought to have considered it as an evidence of much richer argentiferous ore at a greater depth; and to have been induced to examine with more attention the ore from the lowest veins in the shaft at Taplit's and Perry's mine. The next mineralogical object which he notices, and which he describes, (p. 51) as one of the "rarest natural metallic spectacles" he had ever seen, was what he calls a "veinlike mass of submagnetic iron;" this and some other similar beds of iron are upon the public lands, and he gives quite a rapturous description of the benefits to be derived from this discovery; his mode of estimating its value is not however expressed in "terms" quite so intelligible as might be wished. Neither is his description of the iron itself, such as renders it easy of recognition by the mineralogist; for "submagnetic iron" forms neither a species or subspecies in any system of mineralogy, with which we are acquainted: from the circumstance as mentioned in a note, of his suspecting it to contain an "excess of sulphur," it may probably be the magnetic pyrites of Cleaveland, but if so, it is not of much value as an ore. After having sufficiently admired this "extraordinary phenomenon," he proceeded from Missouri into Arkansas, first to Little Rock, and from thence to the Hot Springs of the Washita, and the description of this part of his tour is sufficiently interesting; the most important geological fact, which he mentions in it, is the singular tendency to silification so manifest in that, as well as many other parts of the western country. In the neighbourhood of the Washita Springs, he again met with a bed of iron (he was now provided with a pair of "natural metallic spectacles") which he describes as being magnetic, (a term which we can understand,) and of considerable extent; the situation

in which it is found is remarkable, being an elevated cove or basin-like cavity, based upon greenstone, and surrounded by a circular brim of the same rock. His opinion, that the elevation of this greenstone rock is the result of volcanic action is novel, because we have I believe no instance of any of the trap rocks, having ever assumed the conical form, characteristic of modern volcanic mountains, but it may nevertheless be correct.

(TO BE CONTINUED.)

Franklin Institute.

Monthly Conversation Meeting.

The monthly meeting for December was held at the Hall of the Institute, Dec. 24, 1835.

Mr. Franklin Peale explained the construction of a press for milling coins, about to be introduced by him into the U. S. Mint. The simplicity and efficiency of this machine were much admired. It is adapted to motion by steam power.

Mr. Scott, of Philadelphia, exhibited a fireproof chest, of his invention. The imperfect conductor, which encloses on both sides the wooden frame of the chest, is asbestos; this is protected without, by a stout coating of iron. Mr. Scott stated that one of his chests had been in the cellar of a store burned during the late disastrous conflagration in New York, and that the papers and notes within it were found unharmed, when the chest had been dug from the ruins.

Mr. J. Philbrick, of Natchez, Mississippi, illustrated, by a model, a patented invention for protecting cotton, &c., in the act of drying, from sudden showers. The invention will be submitted, for an opinion, to the Committee on Science and the Arts.

Prof. A. D. Bache, from the Committee on the Explosions of Steam Boilers, showed two cylinders, one of iron, the other of copper, which had been burst explosively, by a gradual increase of pressure. He gave an account of the experiments of the Committee on this subject.

Wood cuts, representing these cylinders, by Mr. R. S. Gilbert, were laid before the members, and were much admired.

COMMITTEE ON SCIENCE AND THE ARTS.

Report on Messrs. Seymour and Whipple's Fire Alarm.

The Committee on Science and the Arts, constituted by the Franklin Institute of the State of Pennsylvania for the promotion of the Mechanic Arts to whom was referred for examination, an Alarm in case of Fire, &c., invented by Messrs. Bradford Seymour and Squire Whipple, of Utica, New York, REPORT:—

That the said alarm consists of a coiled spring of two different metals attached to the wall or threshold support, with one end extending out to form an index, moving a few degrees over the arc of a circle, and serving to move a small hammer, which, at ordinary temperatures, is set in a nearly vertical position against a pivot. But on the temperature being elevated to a given extent, which may be limited at pleasure, the index above mentioned, causes the hammer to fall and raise a sort of trigger, which allows a small weight suspended on the inside of an alarm clock, to descend and set in motion the alarm apparatus.

The inventors have mentioned the purpose of this thermometrical alarm to be to give notice of the occurrence of a fire in any apartment in a building, but the committee conceive that it may answer this and many other purposes, in which it may be desirable to be notified of the occurrence of a given elevation or depression of temperature. The apparatus is neat and even ornamental, and as it appears, to the committee, will answer perfectly the purpose intended by the inventors.*

By order of the committee.

November 12th, 1835. WILLIAM HAMILTON, *Actuary.*

Report on Philip Laibacker's Door Lock.

The Committee on Science and the Arts, constituted by the Franklin Institute of the State of Pennsylvania for the promotion of the Mechanic Arts, to whom was referred for examination, a Door Lock, invented by Philip Laibacker, of Philadelphia, REPORT:

That they have examined the lock of Mr. Laibacker, the improvement in which was stated to consist in a contrivance to cover the key hole; to be used by a person inside, which prevented the introduction of any thing into the lock for the purpose of picking it from the outside.

The lock itself was a specimen of neat and substantial workmanship, of a kind which Mr. L. informed the committee, he had been in the habit of making in Europe; and the application of the safety valve must give it additional security. The manner of effecting this object is by fixing a small sliding plate upon the face of the lock-plate, which, after removing the key, on touching a button at the top of the lock, is shoved by a spring and completely covers the key hole.

The committee believe that the plan before them will fully answer the purpose of guarding and securing the key hole from all pick operations from the outside—but they do not perceive any great advantage it possesses over the common lock with a separate bolt, for supposing a hole to be made through the door to introduce the hand, it would be as easy to remove the cover from the key hole as to draw the bolt.

By order of the committee.

November 12, 1835. WILLIAM HAMILTON, *Actuary.*

Report on Joseph Snyder's Parlour Grate.

The Committee on Science and the Arts, constituted by the Franklin Institute of the State of Pennsylvania for the promotion of the Mechanic Arts, to whom was referred for examination, a Parlour Grate, invented by Mr. Joseph Snyder, of Philadelphia, REPORT:—

That this grate is more properly an open stove, constructed chiefly of cast iron, with a lining of fire clay, and is intended to stand upon the hearth within the apartment. The entablature is supported upon two sheet iron columns, through which the heated air passes from the base to the top of the fire-place. To produce a circulation of the gas and hot air (from the coal) throughout the structure, the flue in the head of the stove is divided horizontally into two compartments.

The lower division into which the gas first passes is connected with a flue descending behind the grate; this flue communicates by means of two hori-

* See vol. xvi., p. 307. [Editor.

zontal passages beneath the grate, with the bases of the sheet iron columns before noticed: these convey the gas into the upper division of the flue at the head of the grate, from which it passes into the chimney. By means of a sliding valve a communication may be opened between the two compartments of the upper flue, so that the gas can pass directly into the chimney without circulating through the fire place. There is another valve beneath the grate, by opening which the air of the apartment is permitted to circulate through the flues and check the draught of the grate.

The committee are unable to speak of the merits of this grate from experiment, as they have not seen it in operation. But from a simple inspection of it, they are inclined to the opinion that it will render available a much larger proportion of the heat of the fuel than is obtained from a grate set in the usual manner; but perhaps not so much as is afforded by a common coal stove. It is however better adapted to parlour use than a stove by its superior neatness and cheerfulness.

Respecting the novelty of this invention the committee will merely remark, that contrivances somewhat similar to this, for retaining the gas and heated air from the fuel within the apartment, have been in use for many years; and that to sustain a claim on this point, the inventor will be obliged to confine himself strictly to a particular form, and not attempt to claim the broad principle upon which its usefulness depends.*

By order of the committee.

November 12, 1835. WILLIAM HAMILTON, *Actuary.*

Mechanics' Register.

AMERICAN PATENTS.

LIST OF AMERICAN PATENTS WHICH ISSUED IN JUNE, 1835.

With Remarks and Exemplifications by the Editor.

1. For a *Lathe for Cooper's Ware;* Isaac Hoover, Miamisburg, Montgomery county, Ohio, July 2.

This, so called, lathe consists of a horizontal platform upon which a barrel or cask, is to be placed and confined by proper dogs, or holdfasts; the platform is made to revolve by turning a winch with a bevil gear, and when the cask is in motion, the tools for champhering, crossing, leveling, &c., properly mounted for the purpose, are held against it. The only claim made is to "the increasing size and power to any extent."

In England and in France the manufacturing of cooper's ware by machinery has been carried to a great extent; but the first establishment of the kind, of which we have seen an account, was in Scotland. Much of the machinery patented here is similar to what has been used for the same purpose there; all the operations which could be performed by giving the vessels, the heads, &c., a rotary motion, have been so performed, and by means the same in substance as that above described.

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2. For a *Stove for Cooking and Warming Rooms;* Ernst G. Augustine, city of New York, July 6.

We cannot discover what it is here intended to patent, but as some of our readers may be possessed of a more acute perception than ourselves, we will insert the whole of what is called the description.

* See No. 16 of remarks, &c., page 43 in the present volume. [Editor.

"This stove is made of cast iron in a pyramidical form; it consists of a furnace in which is burned wood or coal; an ash pit, over which are openings to receive a boiler on each side of the centre columns. In the centre is an opening in which roasting, frying, and baking, are to be performed; over this oven is an opening to receive another boiler. The steam from all these vessels is conveyed in a tube into the chimney and carried off without any inconvenience.

"The invention here claimed and desired to be secured by letters patent consists in the arrangement and adaptation of the several parts of the stove, by which cooking is performed, and the steam carried off, as before described."

Accompanying the specification is a drawing lithographed, and having between thirty and forty references, but these do not give any light as regards the claims of the patentee.

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3. For a *Machine for Cutting Straw;* Ernst G. Augustine, city of New York, July 6.

The claim under this patent is "to the use of a spring fixed below the cutting frame, and attached to it." The remarks upon the preceding specification and drawing apply fully to those now before us.

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4. For a mode of *making Shoes, and rendering them impervious to water;* Ernst G. Augustine, City of New York, July 6.

The soles we are told "may be made of plaited flax, hemp, or the inner bark of the linden tree. For the upper part any kind of cloth may be used, and the shoes lined with linen or cotton. The soles are then varnished or covered with the following composition:—one quart of flax-seed oil, two ounces of rosin, half an ounce of white vitriol, which must be boiled together for half an hour. After which take four ounces of spirits of turpentine, and two ounces of white oak saw-dust, which has been exposed twenty-four hours to the sun: mix these ingredients well together, and put them on the soles of the shoes with a brush or in any other way, which when dried will render them impervious to water."

The claim is to "the above described method of making shoes and rendering them water proof." We do not discover any method of "making shoes" contained in the foregoing description.

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5. For a *mode of making Vinegar;* Frederick W. Boden, New Lancaster, Fairfield county, Ohio; an alien, who has declared his intention to become a citizen. July 6.

In order to make 32 gallons of vinegar, two gallons of beer, ale, or porter, five and a third of whiskey, three ounces of cream of tartar, twenty-four and two-third gallons of water, are to be put together into a mixing tub, and afterwards into a vessel of convenient size for fermentation. The mixture is to drop through small holes in a division near the top of the fermenting tub, and to fall among chips or shavings of wood placed below it; a tube passes down from the top to the bottom, to supply the necessary quantity of air, and it is said that the mixture will become vinegar in about twenty-four hours. The claim is to the foregoing composition, and to the apparatus employed. It is not long since we read a description of the mode of making vinegar rapidly, as practised in Germany, which is as much like the foregoing as it could well be.

6. For an improvement in the *Art of Combing Wool;* Samuel Couillard, Boston, Massachusetts, July 7.

The following quotation will afford some general idea of the principles upon which the patentee proceeds in effecting his object, which is to separate the fibres of different lengths, and to bring them together when thus separated.

After describing the apparatus used, by written references to a drawing, he says, "upon this principle of drawing wool from the belt it can easily be seen that by placing a number of pairs of draw rollers at different distances from the belt, various lengths of wool can be drawn from it."

"What I claim as my invention is the revolving tooth belt, and the application of a card, or tooth cylinder, or cylinders, to comb wool into teeth passing by its surface, to produce the effect before described."

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7. For an improved *Root Cutter;* Jonathan Clarke, Hampton, Windham county, Connecticut, July 7.

There is to be a revolving cylinder with knives placed diagonally, or otherwise, across its periphery, and the roots, placed in a hopper, are subjected to their action. The claim is to a machine having such knives, or slitters, a claim which has as little to support it as a large proportion of those made by patentees.

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8. For a mode of *Applying Horse Power to Machinery;* Thomas Mitchell, Newburg, Orange county, New York, July 7.

An endless floor is to revolve upon cylinders in the usual manner, and under the slats composing it there are to be friction wheels running upon two rails. This apparatus is intended principally to drive thrashing machines.

Where the patentee can have been not to have seen such horse powers, which are extensively diffused over the country, it is not for us to tell, he must have seen but little, or he would not suppose the following claims valid.

"Horse power has been applied in boats on a horizontal wheel. The rotary chain bridge may have been used, but never to my knowledge with a rail-way, rollers, or inclination of the bridge herein described. I claim as my invention the inclined bridge rail-way and rollers, in combination with the other machinery before mentioned, but for which I make no separate claim; and although intended principally for the thrashing machine, I claim also the application of horse power by means thereof to machines for breaking flax and hemp, turning lathes, machinery for propelling boats, and all other machinery to which horse power can be advantageously applied."

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9. For a *Safety Boiler;* George R. Clarke, Rochester, New York, July 7.

There is to be a cylindrical boiler of the ordinary construction, placed horizontally, and within this a second cylindrical boiler, connected with the former, but so much smaller as to allow of a space between the two, of probably two or three inches; the inner boiler is to contain the water, and should this explode, the outer case is to confine the steam, &c. until it has time to be conducted off by pipes for that purpose. The furnace, which extends along the under part of the boiler in the usual way, must, of course, heat the interior vessel without the intervention of the exterior coat.

This whole plan has so little to recommend it, or rather will stand so self-condemned in the view of all those who are acquainted with the subject as to prevent the necessity of animadversion on our part.

10. For *Cleaning Wool from Burrs, &c.;* M. N. Simpson, Boston, Massachusetts, July 7.

After giving a description of the machine intended to be used, the patentee observes that "wool from South America, and indeed almost all wools, have more or less of a vegetable substance, called burrs, so attached to it that it is not taken out by washing, and therefore the only mode of cleaning the wool has been by hand, until about two years since, a mechanic of the city of Boston, Mr. Lemuel Couillard, jr. invented a machine for the purpose, which performed the part of taking out the burr very well, but was set aside from the injury the staples received. The machine for which I now wish a patent performs the work of taking out the burr without any injury to the fibre. The wool should in the first place be well pinched by a common wool pincher, with the burr in it, and in this state the machine receives it; it is placed by the operation, on the feed belt, which when the machine is in operation is conducted to the draw rolls, which revolve very slow, and as the wool is carried through the draw rolls, the card cylinder takes it in small quantities in a thin state, as it revolves with so much greater rapidity than the feed rolls, and carries it in a continued direction by the clipper frame, which is placed nearly in contact with the surface of the teeth, the burrs and all foreign substances are stopped by the blade of the clipper frame, and the swift revolution of the clipper knocks them off. The wool continues in the teeth of the card cylinder, and is overtaken by the fan which is placed on the opposite side of the clipper frame, and is by the fan blown or taken from the cylinder and deposited in a clean state in the room which may be made for the purpose."

It is stated that the machine may be much varied in form whilst the same effect will be produced, and the patentee says, "I do not therefore claim as my invention any particular form of machinery to effect the object of detaching burrs or other foreign substances from wool, but claim the application of knocking, blowing, brushing, or striking the burrs or other foreign substances from the surface of the card teeth, or any other kind of teeth."

We think this claim may prove too broad, as it will be seen on turning to p. 187, vol. 13, that Mr. Couillard claimed, among other means, the "blowing or striking them off," when properly exposed; it may be, however that in the present machine the removal being effected from "the surface of the card teeth," may so far modify the thing as to prevent the one patent interfering with the other.

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11. For a *Thrashing Machine;* Joseph Tyler, Brooklyn, Windham county, Connecticut, July 7.

It is no easy task to find the means of making a cylinder thrashing machine in which there shall be anything admitting a legitimate claim to novelty; and it is quite manifest that the present patentee has not accomplished it. He has placed his main shafts to run upon friction rollers, than which few things are more common in machinery; yet he makes this a main foundation of his claim.

"The present claimant does not seek a patent for the cylinder, for the beaters, for the arbors, nor for the concave, because these parts of said machine have been long in use; but he does claim that the pinion wheel, balance wheels, the friction rollers, their size and proportions, and the modes of their application to this machine are entirely new, and are of the original invention of the present claimant. And also this claimant further claims as his invention, the great reduction of power necessary to propel this ma-

chine, and the great diminution of friction which has heretofore retarded in a great measure, the operation of machines of this description."

The latter part of the foregoing claim is merely to an effect produced, and it is a well established principle in law that a patent for a mere effect cannot be sustained. Any effect produced must result from certain means employed to produce it, and this latter is the only tangible object for a patent.

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12. For a *Water Pump;* Amos Miner, Elbridge, Onondaga county, New York, July 7.

The chamber of this pump is to be made of cast-iron, or other metal, and is to be attached to a wooden pump tree that is to lead down into the well. The wood part is to be coated with a cement of rosin and bees-wax, or other similar articles. Particular directions are given respecting the exact measurement of the respective parts, and the mode of connecting them with each other, but there is not in the description any thing that regards construction or arrangement which is worthy of particular notice, or that is in any respect superior to the pumps now in use. The following claims are made.

"1st. The general construction of the pump. 2nd. The application of the pit of the metallic piston to the cylinder of said pump. 3d. The application of the screw for connecting the wooden pipe, or tube. 4th. The manner of constructing the elbows of the pipe. 5th. The application of the resinous composition to the pipe or tube."

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13. For *Propelling the Stocks of Fulling Mills, &c.;* Elisha S. Norris, Monmouth, Kennebec county, Maine, July 7.

The mode of arranging the levers and joints is different from that usually adopted, but we do not perceive the advantage to be derived from this new plan, or its superiority in the various applications to which, judging from the following claims, it is destined in the mind of the patentee.

"The application of the knuckle joint, or levers, as described, to the fulling mill or washing machine, placing them, as delineated in the drawing, higher up on the stocks. The application of the same to mortising machines, and to the saw mill for sawing timber."

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14. For a *Door Latch and Lock;* Albert Bingham, Unity, Waldo county, Maine, July 7.

Many variations in spring latches and knobs for doors have been patented within a very few years. The claim made by the present patentee is a very brief one, being merely "the application of the dog to the knob as an inside fastening, as described."

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15. For an improvement in the *Compensating Tubes for Piano Fortes;* Thomas Loud, city of Philadelphia, July 7. (See Specification.)

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16. For a *Mortising Machine;* Israel J. Richardson, Palmyra, Wayne county, New York, July 7.

This patent is taken for an improvement upon the machine patented by the above named person, and Joseph Dennis, on the 19th of November, 1833, the improvements being made in the chisel, in the method of securing it and of moving the timber, and in the addition of an apparatus for mortising hubs. For the account of the former patent see vol. 13, p. 263. With the present specification is given an imperfect drawing, in which several of the parts described are entirely omitted, and to which there a e

no written references. The improvements in the chisel consist mainly, in making it of cast-iron, with a cutting edge of cast-steel soldered to it. The articles to be mortised are to be forced up by means of a screw; and the hub apparatus consists of a frame in which to hold the hub, and an index plate by which to set it, neither of which are new, and they are therefore in the same predicament with the original machine when patented. The claims made are not to any part of the apparatus, but to the advantages which may result from them.

17. For an improvement in *Mills;* George and Francis R. Baker, Tuscaloosa, Alabama, July 7.

This patent is one great mistake, as the patentees use drums and belts for driving stones, or saws, and say, "we deem ourselves the first who applied bands, or leather belts, to the propelling of water mills for grinding and sawing." They claim "the arrangement of all the parts;" the whole of which are just as new as the drums and leather belts.

18. For an improvement in the *Common Chisel;* George Payne, Keene, Cheshire county, New Hampshire, July 7.

This chisel is to be made with what are called wings, or side edges, for the purpose of pareing within mortises; they are intended principally to be used in mortising machines, but may be employed by hand. The claim is, "only the wings, or side edges," and even this might have been omitted, as such side edges are not new.

19. For a *Substitute for Linseed Oil;* S. T. Todd, and J. L. Peabody, city of Washington, July 7. (See specification.)

20. For an improvement in the *Saw Mill;* Ernst G. Augustin, city of New York, July 17.

The specification of this patent, and likewise those numbered 2, 3, and 4, are accompanied with drawings, lithographed, and furnished with numerous references; it is quite unfortunate that, although there are these aids, a proper attention to which would have rendered the drawing up of a good specification easy, those referred to all fail in every essential point, leaving us entirely in the dark as regards what the patentee considers himself to have invented. In the present case, the claim is to the "before described improvements, with the arrangement and adaptation of the several parts of the saw mill;" yet we are told in the commencement of the specification, that there is no change in the principal parts of the mill.

21. For *Bending or Setting Felloes for the Wheels of Carriages;* Edward Reynolds, Haddonfield, Gloucester county, New Jersey, July 17.

The patentee says, "What I claim as my invention, is the machine, or apparatus, as herein described, and may properly be denominated revolving cylinders, to be used for the bending of felloes for carriages and wagons of all descriptions; sleigh runners; iron tires for wheels; coopers' set hoops, vessels' mast hoops, &c. In which machine two cylinders are employed, operated together by means of certain accessary parts, in the manner, or upon the principle, herein set forth."

We think the machine described well adapted to the bending of timber for rims for wheels. It consists of two wheels in a strong frame, the peripheries of the wheels being nearly in contact with each other; the timber, prepared by boiling, or steaming, is to be bent round one of them, by turn-

ing the other, which presses forcibly upon it. An iron band laps round the outside of the bent timber, to prevent its checking; and there are proper staples, and other appendages, for the management of the process.

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22. For a *Cultivator;* Daniel Davis, Fredericksburgh, Spottsylvania county, Virginia, July 17.

The operating parts of this cultivator are formed very much like the mould-boards of ploughs, and three, or more, of them are to be attached to a cast-iron frame, which takes the place of the wood generally used in such instruments. The handles are to be of wood, and attached by bolts and sockets to the cast-iron frame. Particular admeasurements are given of the individual parts, which, with the cast-iron frame, appear to be relied on to sustain the patent. The claim is to "above described cultivator," which claim appears somewhat too sweeping.

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23. For machinery for *Rolling up Curtains, Maps, &c.;* Henry Lawson, Boston, Massachusetts, July 17.

The handle by which the curtain, &c., is to be rolled upon its roller, is made much in the form of the old fashioned bell pull, and has a small sheever, or pulley, at its upper end; a cord, one end of which is fastened to and winds round the end of the roller, passes through the pulley, and has its other end fastened to a pin, or other attachment, above; this whole arrangement, it will be seen, is exactly similar to the hanging the weight of a common eight day clock.

"My claim is, 1st, for reducing the length of the draw required to roll up this species of roller blind, shade, curtain, map, &c., to a convenient hand's pull; that is, by one easy move of the hand, to cause the roller to revolve sufficiently to wind up any length of curtain, &c., required for the above purposes.

"2nd. For the pendent balance pulley, and the manner of applying it, as above described.

"3d. For the relative proportions of the barrel and axis, as above described."

All that is said about relative proportions, is, that one part is made *small*, and another *greater*. Rather an indefinite thing to claim.

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24. For a *Churn;* Oliver Wyman, Dedham, Norfolk county, Massachusetts, July 17.

The body of the churn is, in preference, to be square, as being less expensive than if made round; it has in it a vertical shaft, with dashers; the shaft is turned by means of a winch and bevil gear.

The claim is to "the square churn; the construction of the dasher, and the gearing by which it is turned; and the operation of the several parts of the machinery to effect the purposes above specified."

We have seen several square churns; dashers and gearing like the above may be seen over and over again in the patent office; and the operation of the several parts is, of necessity, like the operation of the like several parts in other similar churns; at all events, the operation is not a thing to claim.

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25. For a *Cooking Stove;* John Moffat, and Morton Taintor, Buffalo, Erie county, New York, July 17.

This is intended as an improvement on the "self-heat-retaining stove,"

patented by the above named John Moffat, August 13th, 1834. See vol. xv., p. 190, where the general construction of the stove is so fully set forth, that we need say but little respecting it, excepting to indicate the improvements; these "consist in having the reflectors in the ovens movable, or portable, instead of being fixed. Also, in having a hole near the bottom of the back side of the case, through which air is admitted into the space between the back of the stove, within the case." "Also, the making a steam pipe from the back side of the upper part of the case, to the flue of a chimney, or stove pipe, by which the upper part of the case is ventilated," &c. "And further, that *any kind* of stove which is, or may be, used for cooking or warming purposes, may be enclosed in a heat retaining case, (as described in the aforesaid letters patent, and in this specification,) and used *either for cooking purposes, or for heating air* to warm a house, by means of pipes connected with the several rooms."

"We claim the invention of the last mentioned improvements, as therein expressed."

Now, it is to be remembered, that, if the claim to the heat retaining case was good in Aug. 1834, it cannot be made again in July, 1835, or two patents may be held for the same thing. The parts now claimed as improvements are not adequately described, or clearly represented in the drawings.

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26. For an improvement in the *Manufacture of Potash;* Henry Hartsuff, Tyre, Seneca county, and Cyrus French, Aurelius, Cayuga county, New York, July 17.

The claim is to the "use of dry slacked lime and ashes, in alternate layers, and saturating each layer of ashes with *boiling weak ley*, in which common salt has been dissolved, by which the strength of the ashes is more perfectly obtained in a shorter time, and at less expense."

The directions given are, first, three inches of slacked lime, then five inches of ashes, saturated [moistened] as above; then half an inch of lime, and five inches of ashes, continuing to about five layers of each alternately. Water, or weak ley, is finally to be poured on, until the ashes are exhausted.

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27. For a *Mortising Machine;* Imla Wright, Centre Antrim, Hillsborough county, New Hampshire, July 17.

"The invention here claimed, and desired to be secured by letters patent, consists in the before described machine for mortising timber, with the arrangement and adaptation of its several parts, particularly in the stock, and adjustment of the stock and chisel."

This stereotyped claim will suffice to vitiate almost any patent for a machine to be applied to purposes to which many others have been previously applied; in the present instance, if there was any thing to claim, it must have been contained within very narrow limits, the general construction of the machine being without novelty.

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28. For a *Water Wheel;* Isaac Powell, Laurence, Otsego county, New York, July 17.

This is a reacting wheel, with little, if any, novelty about it; at all events, its characteristic features are not pointed out in the specification; and the claim is to "the before described reacting wheel, with the arrangement and adaptation of its several parts."

29. For a *Plough;* patented October 23d, 1829; patent surrendered and reissued upon an amended specification, July 17.

We have said all that we think necessary respecting this plough, at p. 35, vol. v. The present specification, though amended, does not, of course, alter the thing patented.

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30. For improvements in a machine for *Manufacturing Weavers' Reeds, Headles, or Harness;* Jeptha Avery Wilkinson, Providence, Rhode Island, July 17.

Twenty closely filled pages are occupied by the specification of these improvements on a machine formerly patented by the same gentleman, and twenty-seven figures, with almost countless references in the drawing, forbid any attempt to offer a brief description of a thing consisting of parts "too numerous to be contained in a catalogue."

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31. For an improvement in *Looms;* Oliver C. Burr, Millbury, Worcester county, Massachusetts, July 17.

It is stated that it has been found very difficult to wind cloth upon the beam of a loom with regularity, as it is woven, and that those plans for doing it which have been successful, are too expensive. By the plan now patented, the beam is to move at each flight of the shuttle, instead of at longer intervals, and, if the thread on the spool breaks, the winding ceases.

By a particular contrivance, the proper explanation of which would require the drawing, the latter is made to communicate motion to the cloth beam, through the intervention of an arm, or lever, the employment of which constitutes the claim.

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32. For a *Churn;* Reding Ryerson, Jay, Oxford county, Maine, July 17.

The tub of this churn is to be upright, and in the usual form. A shaft passes through the lid, and its lower end is received in a step on the bottom of the churn. The shaft is to be turned by a face wheel and wallower, in the manner of bevil gear, and upon the shaft there are floats, or dashers, some of which are horizontal, and others vertical; the floats are called "cutting floats," and it is to these that the goodness of the churn is attributed, but in what particular they differ from others, so as to obtain their name and value, we are not informed.

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33. For a *Plough;* Samuel Cline, Plumstead, Bucks county, Pennsylvania, July 17.

The improvement in this plough is said to consist in "placing the line of draught, or beam, so that the resistance to be overcome may bear equally on both sides of that line." The mode of forming the plough so that the beam shall stand in the way mentioned, is particularly described, but this we do not think it necessary to detail.

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34. For a *Washing Machine;* Asa W. Soule, Portland, Cumberland county, Maine, July 18.

This washing machine has beaters, operating much in the manner of those of a fulling mill, and precisely similar to such as have been before used in washing machines. The arms on which these are suspended, are to be worked backwards and forwards by means of cams, having friction rollers on the ends; the cams and friction rollers constitute the claim.

35. For an improvement in the making of *Artificial Stone Coffins;* John White, Syracuse, Onondaga county, New York, July 18.

It is stated that this patent is obtained for an improvement upon that granted to Daniel Dayton, Hiram Hoyt, and the said John White, on the 6th day of June, for making coffins of American Hydraulic Cement. The improvement claimed consists in the filling in of the coffin, whether originally made of the cement, or of wood, with soft cement when the corpse is put in, for the purpose of excluding the air from the corpse, and also supporting the corpse when the coffin is placed in an erect position." When made of cement, the coffin, it is observed, "may be made of any shape desired; and, if to be placed upright, may be in that of a statue, &c.

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36. For an improvement in the *Manufacture of Cloth;* Freeman Wolcot, Stow, Middlesex county, Massachusetts, July 21.

This, so called, improvement in the *manufacture of cloth,* is, it appears, an improvement in the napping apparatus, by substituting combs of brass for the teazles usually employed in that process. These combs are made of strips of elastic sheet brass; the teeth in them are to be about an inch in length, a fifteenth of an inch wide at their bases, and tapering regularly to a point. To these plates "a considerable curvature is to be given by swaying; that is by placing the plate thus cut over a concave mould so fashioned as to give the teeth and plate a proper curvature, and then placing a corresponding convex iron over them, and giving it a blow with a hammer. The metallic napper will then be complete, and will be a plate with a row of curved tapering elastic teeth, resembling the teeth of the teazle, and standing out from the uncut part of the plate at such an angle that the uncut part may be attached to slats of wood passing across [along] the face of a cylinder at suitable distances."

"The invention for which, and for the use of which, the said Wolcot claims his patent, is for making from thin brass, a plate, with curved, tapering, and elastic teeth suitable for napping cloth."

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37. For a *Machine for Shelling Corn,* John P. Small, Gilmarton, Strafford county, New Hampshire, July 21.

This corn shelling machine has a cylinder set with teeth, and a concave against which it operates in the shelling process; it is, in fact, substantially the same with the first corn shelling machine ever invented. The corn falls through an opening at the lower part of the concave, and is cleaned by a revolving fan, in the way frequently practised.

The claim is to "the combination or manner in which the several parts are put together, in the manner above described," which claim might as well have been altogether omitted, as it does not render that new which is actually old.

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38. For an improvement in the construction of *Stoves for Burning Anthracite, and other Fuel;* Jordan L. Mott, city of New York, July 21. (See Specification.)

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39. For a machine for *Manufacturing Corks;* Jonathan Cutler, and Isaac Keyes, Putnam, Windham county, Vermont, July 21.

This cork cutting machine has a mandrel which revolves like that of an ordinary lathe. The cutters consist of four or any other convenient num-

ber of pieces of steel formed at their ends like an ordinary gouge. They are capable of expanding and contracting, as otherwise, they would cut the cork into a cylinder instead of making it conical. Each of the cutters is hinged, by a handle at its opposite end, to the revolving shaft, and there is a collar so contrived as to cause the cutters to approach each other as the cork is cut. In front of the mandrel there is a horizontal wheel, called a feed wheel, around the periphery of which there are notches to receive the blocks of cork wood, which are ready for the machine. A cam causes this wheel to carry each block, in succession, up to the cutters, into the hollow between which it is finally received, and passes out at a proper opening behind the cutters.

"What we claim as our own invention is the expansive, or cutting cylinder, as connected with the other machinery. Every other part of the machine may be constructed differently, and answer the same purposes."

This machine is skilfully contrived, and described with sufficient clearness; the claim, also, we think well expressed and sufficiently guarded; still, we have doubts of the eventual success of the plan, from the intrinsic difficulties which present themselves in the cutting of cork by machinery. There have been several patented contrivances for the same purposes, but we believe that neither of them has stood the test of continued use. Those who are acquainted with the operation of cutting corks by hand know that a thin and sharp knife is employed for the purpose, and that the edge of this knife is preserved by passing it over a piece of wood between every two or three cuts, the workmen doing this dexterously with one hand whilst the other is employed in taking up a fresh block; without this fine edge the cutting cannot be effected, and we think that in a machine it can scarcely be preserved. Besides this, from the varying thickness of the cork wood, it is no easy matter to have the blocks all of one size. In cutting by hand this is of no consequence, while in cutting by machinery it is all important.

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40. For an improvement in the *Combined Stove;* for which a patent was obtained on the 13th of December, 1833; Jordan L. Mott, city of New York, July 21. (See Specification.)

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41. For an improved manufacture of *Knobs or Handles for Stoves or Grates;* Jordan L. Mott, city of New York, July 21.

"My new manufacture consists in the employment of a material for making knobs, or handles, and for the above named purpose; which material is the metal denominated zinc, or spelter. I cast such knobs or handles either in moulds of metal, or in sand, in separate hollow pieces, and unite the same together by means of pins, or screws passing through them in the manner commonly pursued in uniting the parts of brass or other knobs employed for drawers or other purposes."

The claim corresponds with the above statement.

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42. For a *Churn;* Hiram Phelps, Willeston, Chittenden county, Vermont, July 21.

This churn is to be a square box, standing on legs, and having the bottom concave. Within the box a shaft is to be made to revolve, the floats of which come nearly into contact with the bottom. The particular arrangement of the floats, and the advantages which the patentee thinks will be derived from them we leave to be recorded by some future historian.

43. For the *Application of Asbestos to protect fire proof chests, &c. from the influence of excessive heat;* John Scott, city of Philadelphia, July 21.

"My improvement consists in the application and use of the same material (asbestos) in combination with substances and articles which have heretofore been exposed to the influence of fire without it, but will now derive greatly increased security and protection from its use. These articles are fire proof chests, boxes, closets, doors, and their different parts."

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44. For an improvement in the *Slide Valves for Steam Engines;* Andrew M. Eastwick, city of Philadelphia, July 21. (See Specification.)

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45. For a *Rotary Steam Engine;* Mason Young, Buffalo, Erie county, New York, July 21.

This machine is denominated "the spiral spring float propelling Rotary Steam Engine." Like most of its predecessors, it will prove a total failure. We do not mean by this assertion that it will not work, but merely that it will be found very inferior to the reciprocating engine, and that it will not, therefore, be kept going. A wheel is to revolve within a drum, or case, and this wheel is to have buckets, or floats, against which the steam is to act. These floats slide through mortises in the periphery of the wheel, and have shanks furnished with spiral springs to protrude them. They slide in as they pass a stop against which the steam is to react in driving the wheel. Those persons conversant with the miscarriages and abortions which have taken place among those enceint with rotary steam engines will at once perceive that in the foregoing affair there is nothing new in principle, and but little in arrangement.

How widely we differ from the patentee will appear by the subjoined quotation; our difference we apprehend, however, will be but temporary, as actual experiment, will, most probably, convince *one of us*, of his error.

"The advantages the foregoing application of steam possesses, consists in overcoming the *friction*, occasioned by the old method of crank and piston. Also obviating the difficulties arising from the *dead centres*, in the use of the crank and piston plan.

"By the invention or improvement above mentioned it is insisted that nearly all the lever purchase of the wheel is secured. That the expense of construction is greatly diminished, thereby bringing the steam engine into more common use. Lastly: a consideration more weighty than any other, the saving of fuel necessary in generating steam by this new method, by which less steam performs more labour according to the given diameter of the wheel, in nearly an inverse ratio.

"I claim, therefore, the application of the aforesaid method of using steam, as well as the manner of constructing the wheel with its appendages, the cam, or eccentric used in the shell, together with the manner of making the boxes with spiral spring."

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46. For *Cutting Tenons on Spokes;* William Gerrish, Portsmouth, Rockingham county, New Hampshire, July 21.

This machine is for cutting round tenons by means of a revolving cutter, having in its centre an opening of the size proper to admit the tenon. There are to be three, or any other convenient number of, cutters projecting from the face, which forms the shoulder.

Such cutters have been used for many years for similar purposes, both in braces and in lathes, and there is not any thing in that now presented, essentially varying from, or in any respect superior to, those well known to workmen.

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47. For a *Churn;* Russel Bradly, Williston, Chittenden county, Vermont, July 21.

This churn is so much like that No. 42, as to be evidently struck by the same die, notwithstanding the change in the superscription.

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48. For *Stoves;* Daniel West, and Ferdinand Van Sickle, Hudson, Columbia county, New York, July 21.

This stove the patentees call "*the external draught and rarifier,*" and they say that "a more uniform, and a greater degree of heat is produced by the combustion of the same quantity of fuel, than in any other manner." The claim made is to "the rarifaction of the air, obtained from the outside of the room or building, before it is supplied or used for the combustion of the fuel, and the warming or heating the room or building with the surplus of the rarified air beyond what is necessary for the combustion of the fuel; also the grate aforesaid, whatever may be the construction, or however adjusted."

The stove consists of one cylinder within another, the inner one forming the furnace part, and projecting above the exterior case sufficiently high to have a door in it for the supply of fuel, and a opening for the smoke pipe.—Air is to be admitted from the outside of the room into the space between the two cylinders, a portion of which is to pass through an opening to feed the fire, and the remainder through perforations at the top of the exterior cylinder, to heat the room.

The grate is to be a convex segment of a sphere, and is to have a handle with which to tilt it. The whole affair is treated as though it were entirely new, instead of entirely old, with the exception, at most, of allowing a portion of the air from between the two cylinders to feed the fire; and this part is of little importance as it might be as well fed from a portion of that in the room.

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49. For a *Double Dasher Churn;* William A. Henrich, Greene, Kennebec county, Maine, July 21.

The churn may be of the common construction, with the exception of there being two dashers, one alongside the other; these are to be worked up and down by means of a crank, or lever, which is the thing claimed, but by how many we have not time to count.

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50. For a *Machine for Cleaning Rags;* William Debit, Hartford, Connecticut. First patented January 13th, 1829. Reissued on an amended specification, July 21.

The specification of the original patent will be found at p. 270 vol. iii. The claim in the present specification is in the following words.

"I do not claim as my invention the common duster, or any of its parts; nor the plates, the knives, or beaters, the hollow axles, the shafts, nor, in short, the several parts of the machine, taken by itself. But I do claim as my invention the aforesaid combination of the shaft, and said knives or beaters with the common duster, improved by said horizontal knives or plates

on the ribs, made to revolve so that the knives or beaters on the shaft shall pass rapidly by the ribs and plates of the duster. By these motions and combinations of parts, the rags are agitated, beaten and cleaned."

51. For a mode of *Regulating the height of water in Steam Engine Boilers;* Jesse Fox, Lowell, Massachusetts. Patented April 2nd, 1835; surrendered and re-issued, July 21.

We noticed the former specification at p. 306 of the last volume. The patentee has surrendered this patent, and has put in two new specifications, upon which two new patents have been issued; a procedure sanctioned by former practice, and also by the opinion of the Attorney General.

Without a plate and a very long description, the mechanical arrangement proposed by the patentee, cannot be made known; all we can do is to give a quotation in which the principle of the invention is set forth.

"The principle consists in ascertaining whether water or steam be at any point in a steam engine boiler when in use and operation, by means of a change produced in the action of a piston or plunger moving in a chamber of about four cubic inches, capable of holding in confinement the steam made in such boiler, and having a valve by which the steam or water, as either may be at such point during the operation of the engine, may enter from such boiler into such a chamber, and be confined there for an instant, while the plunger descends therein by means substantially as aforesaid; and the presence of either being ascertained by the change in the action of such plunger in the mode substantially as above described."

52. No. 2 of the foregoing.

To afford some idea of the difference of the modes described in the two specifications, we give the following quotation.

"It is now apparent that the change in the supply is produced by the compressibility of steam, and the non-compressibility of water made effective by machinery; steam opposing no resistance to the descent of the plunger suffers the dog to descend and draws the supply rod away from the boiler, thus increasing the supply as aforesaid; but water resisting the descent of the plunger, and arresting the plunger in its descent for an instant, thereby makes the plunger a temporary prop, and a centre of motion for the lever which is made to work thereon, and lift up the dog, so that the spring shall throw its lower notch upon the catch, and thereby carry the air towards the boiler, and with it the rod, thereby diminishing the supply of water."

Specifications of American Patents.

Specification of a Patent for an improvement in the Slide Valves for Steam Engines. Granted to Andrew M. Eastwick, *city of Philadelphia, July 21st,* 1835.

To all whom it may concern, be it known, that I, Andrew M. Eastwick, of the city of Philadelphia, in the state of Pennsylvania, have invented an improved slide valve for steam engines, by means of which the action of the engine may be reversed with the utmost facility, thereby rendering this improved valve of special utility in engines for steamboats, locomotives for rail-roads, and for other purposes; and I do hereby declare that the following is a full and exact description thereof.

The slide and steam chest do not differ in their general construction from those in ordinary use, but to the latter an increased length and depth are given, to admit of an additional sliding piece, which I denominate a *Reversing shifting valve seat*, and upon the use of which my improved valve is dependent; the permanent valve seat, also, upon the body of the cylinder, is furnished with openings into steam ways leading into each end thereof, and with an escape opening, which do not differ from those in ordinary use.

The reversing shifting valve seat, above alluded to, has five openings in it, three of which pass directly through it, and are so situated during the ordinary action of the engine, as to coincide with the steam ways, and discharge opening upon the cylinder. The other two openings do not pass directly through the shifting valve seat, but each of them, after descending nearly half way through the seat, is continued laterally, passing along by the ends of two of the direct openings first described, and terminating on the opposite face of the shifting seat; the two lateral communications are at opposite ends of the direct openings. By this arrangement of these two extra openings, the steam which is admitted into one of them, does not pass into the steam way which is directly under it, but into that leading to the opposite end thereof. In consequence of constructing the shifting valve in this manner, all that is necessary to reverse the motion of the engine, is to slide the shifting seat so as to bring the reversing openings into action, and to throw the ordinary openings out of action. For this purpose, a rod connected with the shifting valve seat passes through a stuffing box in the steam chest, so that, by means of a lever, cam, or other contrivance, it may be instantaneously shifted in either direction; the steam chest must, of course, be made of such length as is necessary for this purpose. The openings which are not in action are closed by the divisions between the steam and discharge ways, and by the solid parts of the valve seat.

What I claim as my invention, is the construction of the reversing shifting valve seat, containing the reversing openings, constructed upon the principle, or in the manner, herein set forth, whether the same be made precisely in the form described, or in any other which is substantially the same, producing a similar effect by analogous means.

ANDREW M. EASTWICK.

Specification of a Patent for an improvement in the Construction of Stoves for burning Anthracite, and other Fuel. Granted to JORDAN L. MOTT, *city of New York, July 21st,* 1835.

To all whom it may concern, be it known, that I, Jordan L. Mott, of the city of New York, in the state of New York, have invented an improvement in the construction of stoves for burning anthracite, and other fuel, which improvement is applicable also to retorts for gas works, and to other instruments for the generating or applying of heat. And I do hereby declare that the following is a full and exact description thereof.

For the purpose of description, I will suppose a vertical, cylindrical stove to be constructed, observing, however, that I do not intend thereby to limit myself as respects the form, position, or application, of the apparatus, but only to give an exemplification of a practical mode of carrying the principle of construction into effect.

The body, or furnace part, of this stove, is to be of cast-iron, and consists of any required number of separate rings, of such internal diameter as

may be required for the furnace. These rings are to be placed, or superimposed, upon each other to the required height; rims, or ledges, and corresponding grooves, or hollows, being cast upon their touching sides to keep them in their places. Holes are also to be cast in them, or ears formed on them, to receive rods, by which they may be confined together. The lower part of the stove, forming the ash pit, and its appendages, and also that part which is above the fire, may be constructed in any of the usual forms, or of any of the ordinary materials; the improvement made by me consisting entirely in the construction of that part which is formed of rings, or rims, in the way described.

I intend usually to form these rings so that, when put together, the interior of the furnace shall, by their junction, have a uniform, continuous surface, either cylindrical, conical, or otherwise, whilst the outside shall be fluted, ribbed, or grooved, so as to expose a large surface to the action of the external air, as this mode of forming them will, by its extended radiation, tend to prevent their being over-heated.

When used for gas retorts, their outsides will form one continuous surface, as best calculated to receive the action of the fire by which they are to be heated. When used in tubes for the conveyance, distribution, or management, of heat, they must, of course, be so formed as to adapt them to the particular purpose to which they are to be applied.

What I claim as my invention, and desire to secure by letters patent, is the forming the exterior, or shell, of furnaces, or fire-places, for stoves of various kinds, the bodies of gas retorts, and other apparatus which are to be exposed to great alterations of temperature, by the combination of separate rings, rims, or frames, of metal, usually of cast-iron, by which means any difference of expansion in the respective parts may take place without the danger of breaking, whilst any portion which is defective may be easily removed, and its place supplied.

JORDAN L. MOTT.

Specification of a Patent for an improvement in the Combined Stove, for which a Patent was obtained on the 13th of December, 1833. *Granted to* JORDAN L. MOTT, *city of New York, July 21st*, 1835.

To all whom it may concern, be it known, that I, Jordan L. Mott, of the city of New York, in the state of New York, have invented an improvement in the manner of constructing the stove for which letters patent of the United States were granted unto me on the 30th day of December, 1833; and I do hereby declare that the following is a full and exact description of my said improvement.

The combined stove, so called, and patented by me as above, was intended to unite the advantages of the close stove with those of an open fire-place; and I have heretofore been in the practice of casting the front part thereof in four separate pieces, namely, a front piece, two jambs, and the inclined plane, or curved plate, (described in my former specification,) which conveys the fuel into the grate; but I have found this procedure to be productive of considerable inconvenience, inasmuch as the ordinary defects in casting frequently rendered it difficult to adapt these pieces properly to each other, and more especially from the burning out of the lower edge of the inclined, or curved, plate. To obviate the first of these difficulties, I now cast the entire front, consisting of the inclined, or curved, plate, the hori-

zontal plate above it, forming the front of the close part of the stove, and the two jambs, from a single pattern, in one piece, with the exception of the lower and middle part of the inclined, or curved, plate, which, in order to obviate the second difficulty above alluded to, namely, the burning out of that part thereof which is in contact with the fire, I usually cast in a separate piece. This separate piece I make of sufficient length and width to sustain the whole effect of the fire, so far as the burning out of the curved, or inclined, plate is concerned; the separate piece, so cast, is received in a recess corresponding therewith, in the inclined, or curved, plate, and is retained in its place by suitable ledges, and a screw, or pin, attaching the two parts to each other. To give strength and durability to this separate piece, I form ridges, or reeds, along, or across, the outside thereof, leaving the inside smooth for the ready descent of the fuel. Although I prefer to make a separate plate in the way described, as, in case of its burning out, it is then readily renewed, without disturbing any other part, I sometimes merely form ridges, or reeds, upon the outside of the inclined, or curved, plate, cast in one continuous piece with the parts before named; such ridges, or reeds, occupying the part liable to be burnt out, and considerably increasing its durability.

What I now claim as my improvement on the combined stove, as patented by me at the within mentioned date, is the casting the entire front thereof in one piece, in the manner set forth, with the addition of ridges, or reeds, upon that part of the curved, or inclined, plate which is directly exposed to the fire; I also claim the making, or casting, of that portion of the inclined, or curved, plate which is so exposed, in a separate and distinct piece, in the manner, and for the purpose, herein fully set forth.

JORDAN L. MOTT.

Remark by the Editor.—We have a small stove of the above kind in use as a chamber stove, and have found it to operate extremely well. The coal burnt in it is such as we should formerly have considered as refuse, and which would have been thrown away.

Progress of Theoretical and Practical Mechanics.

Report on the use of the Hot Air Blast in iron Furnaces and Foundries. By A. GUENYVEAU, *Engineer and Professor in the Royal School of Mines.*

(Translated for this Journal, by Professor A. D. Bache.)

[Continued from p. 66.]

The following details confirm the abstract of results just given.

1*st*. *Furnaces using coke or coal.*

The results as to economy by using the hot air blast are stated, in the Scottish works, as nearly 3 to 2. At Vienne, the same quantity of coke which was used for 1.075 of ore and flux in the charge, is now used for 1.51. At La Voulte, where the air is heated only to 320° in the manufacture of iron for forging, 1 part of coke is now used to 2.1 parts of ore and flux. At the furnace of Terre-Noire, 1 lb. of coke is used to 1.82 of the mixed ore and flux.

At Torteron, where a mixture of coke (1-3) and charcoal (2-3) is used as fuel, 1 lb. of the fuel is used to 2.83 lbs. of the mixed charge, with the hot air blast. While at the furnace of Guerche, where they use the same ore,

flux and fuel, but with the cold air blast, 1 lb. of the fuel is used for 2.98 lbs. of the mixed ore and flux.

At Ancy-le-Franc where charcoal is used, in the proportion of 2-3 oak charcoal and 1-3 of white wood, 2.1 lbs. of the ore and flux require 1 lb. of fuel with hot air, and 2.5 lbs. require the same fuel with heated air. At Wasseralfingen, the increase of the mineral charge when hot air is used is 1.43 to 1, and at Riouperoux, 1.42 to 1.

When iron for forging only is made, and fuel is scarce, it is thought that the hot air blast will be of but little advantage; the company who use the patent for this blast have stipulated for the Creusot furnace, not to pay for the construction of the heating apparatus, in case no real advantage is derived from its use.

In those furnaces which use the hot air blast, and where the mineral part of the charge has been increased, the charges pass less rapidly than formerly, and there are, of course, fewer charges in a given time, but so much more ore passes in the same time that the run of iron is much increased. This increase is greater when the iron is made of the quality for forging than when made for casting. At Vienne, where iron of the second mentioned quality is manufactured, the daily yield has increased in the ratio of 1.22 to 1, while at Janon, where that of the first named quality is used, the ratio is 1.6 to 1. At La Voulte, they produce in twenty-four hours 8 or 9 tons of iron for forging, and it is stated that with an increase of the blast, the yield could be increased to 11 or 12 tons without injuring the quality of the iron.

The greatest advantage from the hot air blast is undoubtedly to be found in the diminution in the enormous quantity of fuel (coal) used in some of the English works. The results obtained in the works of the south of France are the following. At Vienne where they chiefly make iron for casting, they tried the Clyde form of heating apparatus, but abandoned it for that of Calder, by which they heat the air above the melting point of lead. The economy of coke has been in the ratio of 1.37 to 2.50. And the daily yield has increased from 4½ to 5 or 6 tons of iron. The daily product of the two furnaces at Janon, where Taylor's heating apparatus is used, is 8 or 9 tons of iron for forging, by the consumption per ton of 1.20 to 1.40 of coke. This does not include the fuel required to heat the iron. Each of the three furnaces of La Voulte turn out 9 tons of iron for forging, while with the cold blast they made but 7½ to 8 tons of the best quality, under the most favourable circumstances. The consumption of coke is now 1.25 to 1.30 tons for each ton of iron, besides about 600 lbs. per ton, which is required to heat the blast; the former consumption was 2.10 to 2.30 tons of fuel for one of iron. The experiments made in France with crude coal and the hot air blast, have not been conclusive in regard to its advantages, compared with the cold blast.

At the new Torteron furnace where charcoal (2-3) and coke (1-3) are used, the consumption of fuel is about the same for the two kinds of blast. With the hot air blast, however, they make excellent pig iron for castings without any difficulty.

2. *On the use of raw coal in smelting furnaces.*

The substitution of raw coal for coke is doubtless the source of the very great economy observed in the Scotch works, where the heated air blast has been introduced. It was generally believed in this country, as late as 1833, that the hot air blast was indispensable to the use of the fat varieties of coal, without cokeing. It was known that certain dry, bituminous coals,

might be used as fuel, even without admixture with coke, and without heating the blast, as is still practised in Wales.

In some of the English furnaces, on account either of the cakeing of the coal, or of its containing a considerable proportion of sulphur, coke is still used with the hot air blast. In one of the Welsh works, they partly coke the coal, and with good effect; a hint which may, perhaps, be improved upon here.

The following observations on the use of coal, of different qualities, with the common blast, have been collected.

A carbonate of iron was advantageously smelted at Vizille,* with a mixture of coke, and of very compact anthracite, with the cold air blast. The high price of the coke rendered the manufacture unprofitable. It has been found at Creusot, that raw coal could be mixed with the coke used, in the proportion of fifty per cent. of the whole fuel, without injury to the quality of the iron, and without diminution in its quantity. At Decazeville, M. Coste found that all the neighbouring coals could be used with the cold air blast, and the furnaces there, as well as at Firmy, have since used no other fuel, except when it was necessary to work up the fine coal. The same weight of raw coal is now used as was formerly of coke. The pig iron has not deteriorated in quality, and the daily yield is the same as before, namely, about five tons.† In all these cases, there is an advantage resulting from the less quantity of earthy matters in the charges, than when coke is used; it has been found at Decazeville, that they require but half the quantity of flux used with coke, when raw coal is substituted for it.

A fact of an opposite kind was presented at Alais, where an attempt to mix raw coal with coke was unsuccessful, the yield of the furnace being sensibly diminished when the coal was but one sixth of the charge. The coal appears, nevertheless, to be well adapted to this purpose.

At several of the furnaces, such as Terre Noire, &c., coke made from the fine coal is cheaper than the coarse coal, and no advantage can be realized by the use of raw coal.

In regard to the different kinds of coal, it has been observed that those which cake too much, or which fly to pieces, are both ill adapted to use in the smelting furnace. As to other varieties, they may be used either with or without admixture of coke.

The question as to whether the hot air blast is, or is not, necessary, seems to be undecided, observations being contradictory. It is possible that some kinds of coal may render the use of the hot air blast advantageous, or even absolutely require it, while others may work well with cold air. Some may require the hot air blast to drive off the bitumen before they reach the boshes, while others may not need such aid.‡

3. *Smelting furnaces where charcoal is used as a fuel.*

These furnaces requiring a less draught, and being lower than those for coke, are peculiarly well adapted for placing the heating apparatus at the trunnel head. At Wasseralfingen, the pipes are nearly vertical, and pass from the lower part of the furnace to the platform, and back again to the tuyeres; at Ancy-le-Franc they are nearly horizontal, and directly above

* For an account of these important experiments, see this Journal, vol. xv., p. 346.

† In 1835, it is stated that the same furnaces run six tons per twenty-four hours.

‡ It is stated that, at Fredericksbutte, in Silesia, a successful attempt has been made to smelt with raw coal as a fuel, and with the cold air blast. The coal does not cake readily. (Erdman's Chem. Journ.)

the trunnel head. An apparatus formed of curved pipes, passing in an arched form over the trunnel head, has been proposed by Mr. Taylor, but appears not to be as durable as that just referred to.

The experience of several years has proved that the heat of the combustible matters which take fire on issuing from the trunnel head, and of the other gaseous matters, will raise the temperature of the blast to 570° Fah. To this method of heating, several objections have been made; first, that in a well constructed furnace, the air issuing at the trunnel head should not be at as high a temperature as that required for the blast. This objection is not founded on observation, for, besides the heated gases which escape, and which do not burn, there are combustible ones escaping which take fire at the trunnel head, and give out heat by their combustion. It is a well known fact, that, in many works in France and Germany, the heat which would, otherwise, be lost, is applied to various useful purposes. A second objection is, that this mode of heating is dependent upon the proper working of the furnace, and may fail at the very time that heat is required to remove an obstruction in the furnace, from the effect of the very obstruction which is to be removed. This difficulty is easily obviated by burning a few faggots in the flues containing the air pipes, when extra heat is required.

In fact, this apparatus has proved generally satisfactory, requiring neither additional fuel, nor attendance. The exterior of the tubes should be cleaned about every fortnight, to remove dust, and other matters, which would impede the communication of heat. The cleansing of the long horizontal pipes, such as are used at Torteron, is an inconvenient matter.

It may be well to repeat, here, the results obtained by the hot air blast at Wasseralfingen. At a cost only of the construction and repairs of the heating apparatus, the daily yield of the furnace was increased thirty-nine per cent.; the quality of the iron, for casting, was not deteriorated; and the consumption of fuel was diminished from 1 to .61. The temperature of the air was from 390° to 400° Fah.

At Ancy-le-Franc, the consumption of charcoal per ton of iron was diminished twenty per cent., while the iron was improved for castings. The air was heated to 570°. The want of power of the blowing machine prevented a due supply of heated air, and the daily yield of the furnace was decreased.

I have been informed that there are several works in Franche-Comté, where they heat the air blast from the trunnel head. They have a greater daily yield, and consume less fuel than formerly, but state that the working of the furnace is not so regular as before. This, probably, depends upon some defect in their construction, since it certainly is not a usual accompaniment of the hot air blast.

At Hayange, (Moselle,) a furnace twenty-six feet in height, and using charcoal, was supplied with the hot air blast. By means of an apparatus like that used at Wasseralfingen, the air was raised to 612° Fahr., and even above this point. The area of the blast pipe was doubled, and the pressure slightly diminished. The charge of ore was increased from 430 lbs. for 22½ cubic feet of charcoal, to 680 lbs. The same number of charges were made per day, and the gain resulted only from the increase of ore in each charge. The heating apparatus has required no repairs since its establishment, a year ago. In another furnace, at the same place, the heating apparatus having given way, the cold air blast was resumed at an additional expense of twelve per cent. of charcoal, per ton of iron.

It is stated in a German journal,* that, by heating the air from a hydraulic blowing machine, by an apparatus at the trunnel head of a furnace, a saving of twenty-five per cent. of fuel had resulted. The air was heated to 480° Fah.

At Plons, in Switzerland, they have used the hot air blast to advantage, the fuel being a mixture of wood and charcoal. Each charge consists of 81 lbs. of charcoal, nearly half being from hard, and the rest from resinous wood, and 198 lbs. of pine wood, which would have yielded 48 lbs. of light charcoal; of 220 lbs. of ore, containing 51 per cent. of iron, and 60 lbs. of an argillaceous flux. From 18 charges they obtain, in twelve hours, 20,196 lbs. of pig iron. The economy is reckoned at about 33 per cent.

These results are more satisfactory than those furnished by charcoal, alone, and cold air, or even than those afforded by charcoal and the hot air blast. So successful are they considered, that a saw mill has been established to cut the wood to the required size.

[TO BE CONTINUED.]

Hunter's Patent Stone-Planing Machine.

In March last, a patent was granted to Mr. James Hunter, of Leys Mill, Arbroath, "for certain improvements in the art of cutting, or what is commonly called facing and dressing certain kinds of stone." The specification of Mr. Hunter's method has not yet been enrolled; but from a Report, with a copy of which we have been favoured, made to the proprietor of the Leys Mill Quarries (W. F. L. Carnegie, Esq.) by Messrs. Carmichael and Kerr, engineers, of Dundee, who were invited to see the method in actual operation at these quarries, and to verify the results, it appears to be immensely superior to any other hitherto devised. Mr. Hunter has seemingly realised that great desideratum, a power-machine for the cutting and dressing of stone, capable of withstanding the extraordinary friction to which it must be necessarily subjected. The dispatch with which immense blocks of stone are cut up and dressed, by Mr. Hunter's apparatus, is prodigious; yet the cost of tools is next to nothing—"only a half penny-worth of steel for every hundred feet of planed surface?"

Report of Mr. Charles Carmichael, and Mr. John Kerr, Engineers, Dundee, on the power of Mr. James Hunter's Stone-planing Machine.

Sir,—Agreeably to your desire, we have visited Leys Mill Quarries, and attended minutely to the performance of the stone-planing machines. These machines do their work most effectually, as the following experiments, which we witnessed, will testify.

Experiment First.

We went to one of the machines that had six stones laid on the bench, one of which was planed, and the second begun to be operated upon; while this was doing we took the dimensions of the other four stones, viz.:—

Number of Stones.	Length of Stones.		Breadth of Stones.		Thickness.	Finished Thickness.	Quantity taken off.
	Feet.	*Inches.*	*Feet.*	*Inches.*	*Inches.*	*Inches.*	*Inches.*
1	5	3	2	6	3½	2½	1
2	5	0	2	8	3	3⅜	⅝
3	5	6	2	6	6	4¼	1¾
4	4	0	2	3	4	2½	1½

* Erdman's Journal, vol. xviii., p. 340, 1833.

The average thickness of the above stones are given, but many parts of them were much more than the thickness stated. One of the broad finishing tools was blunted ere the experiment began, and was changed when No. 2 was in the operation of being planed. No. 3 was a very hard stone, and was what is technically called yolk, in planing which one of the roughing tools broke at the point; still it wrought out the stone, and was then replaced. A splinter came off the face of the last stone, when about half-finished, which was another cause of delay, as they had to go over it again; but, notwithstanding the delay occasioned by the breaking of one tool, by another being changed, and by having to go over the one-half of the last stone twice, yet the time altogether was forty-five minutes, being at the rate of sixty-five superficial feet per hour.

Experiment Second, (same machine.)

Five stones were now put on the planing machine, of the following dimensions, viz.:—

Number of Stones.	Length of Stones.		Breadth of Stones.		Thickness.	Finished Thickness.	Quantity taken off.
	Feet.	*Inches.*	*Feet.*	*Inches.*	*Inches.*	*Inches.*	*Inches.*
1	4	3	2	2	$4\frac{1}{4}$	$2\frac{1}{4}$	2
2	3	9	1	10	$4\frac{3}{4}$	$3\frac{1}{4}$	$1\frac{1}{2}$
3	3	4	2	8	6	4	2
4	3	6	2	0	$6\frac{1}{2}$	$4\frac{3}{4}$	$1\frac{3}{4}$
5	3	8	3	6	$5\frac{1}{2}$	$4\frac{1}{2}$	1

These stones were planed in forty-two minutes.

The above stones were taken from the quarries without selection, and the men that were working the machine were not informed of the object of our visit. Experiment First, began at half-past twelve o'clock, noon, and Experiment Second, was concluded at nine minutes past two; thus leaving twelve minutes for cleaning and reloading the bench of the machine. Had all the stones been $5\frac{1}{2}$ feet long, they would have been planed in exactly the same time, for the machine travels the distance for that length; so that nearly sixty-seven feet of surface would have been planed in forty-two minutes.

The stones, as they come from the machine, are remarkably smooth and straight on the face; and were it not for the shade left by the tools, we would be apt to think them polished, as they feel as smooth as a polished stone.

We were told by the foreman that, during the last week, there was planed 4,400 superficial feet, more than half of which was planed on both sides (indeed more than half of all the stones that leave the quarry are planed on both sides), by four machines. We saw the payment list for the week; the amount was - - - - - - - £6 1 6

Add blacksmith for dressing and grinding tools - - 0 12 0

£6 13 6

We were further informed by the manager that, during the last summer, there were upwards of 100,000 feet of pavement planed by four machines; and there was one thing that struck us most forcibly, which is the small degree of wear on the tools. Three shillings a week, or six pence per day, is the cost of the labour for dressing and grinding the tools of one machine; and the whole consumption of steel during the last year was under one hundred weight, so that, if we measure both sides of those stones that were actually

planed on the two sides, it will be seen that a pound of steel will plane 1,500 feet, or about a halfpenny-worth of steel for every 100 feet of planed surfaces.

There are now five machines working in the quarry, wrought by a steam engine of six-horse power, the steam cylinder of which is 16 inches diameter, stroke 2 feet. Besides the machines, the engine has to work two inclined planes, one of which is for dragging up the pavement from the quarry to the machines; the distance on the incline 48 feet, ascent 1 foot in 5; average quantity about thirty tons per day of ten hours.

The second incline is for dragging up the rubbish from the quarry to the place where it is deposited; distance 87 feet, ascent 1 foot in 4; quantity from 50 to 60 tons per day of ten hours.

The above shows what the engine is actually doing; and we have no hesitation in saying that the engine could work eight machines besides the inclines, without being overloaded; and our opinion is that a machine, on the average, is not much more than one-half horse power.

Note by Mr. Carnegie.

To explain the difference which is apparent between the quantity of planed stone, which, according to the statement of the engineers, *might* be produced in a given time by the machines, and the quantity stated to them as in one week actually sent to market, it is necessary to remark,—1st, That it is found in practice to be cheaper to dress the stones by the machine in the rough state and shapeless form in which they are taken from the quarry, and to square them by hand afterwards, than to follow the opposite course, as is done when the whole work has to be performed by hand; thus a great quantity of work measured by the engineers, but not available in the market, is nearly lost. 3d. A considerable quantity is required to be dressed over twice on one side, or on both sides, according to circumstances; thus the stones, No. 3, in Exp, 1, and Nos. 2, 3, 4, 5, in Exp. 2, being too thick, were redressed on the under side to suit the market. 2d. The quarry does not always afford stones of a size to fill the benches, when much power is lost, as the machine has to traverse the whole width. 4th. Other circumstances (such as bad weather, &c. &c.) which will readily present themselves to the minds of those conversant in these matters, always occur to prevent general results from attaining the extreme limit, which may be calculated as possible, from the data of a short experiment. Mr. L. C. having been present, can confidently testify as to the correctness and impartiality with which these experiments were conducted, and to the truth of the information furnished to the engineers by those in his employment.

Lond. Mech. Mag.

A TABLE

Showing the number of Houses supplied by the Water Companies of London, &c.

According to the Returns made to Parliament, in 1834.

Name of Company.	Number of Houses supplied	Gross annual Income.	Average annual Expenses.*	Height of supply abo. Thames.	Aver'ge dail sup. to each House.	Average ch'ge. for water per House.†	Amount of capital employed.	Average value of each share.	Profit per cent. on the capital.
		£ s. d.	£ s. d.	Feet.	Galls.	£ s. d.	£ s. d.	£ s. d.	£ s. d.
New River	73,212	104,909 0 0	38,000 0 0	145	241	1 6 6	1,116,964 0 0	15,512 0 0	4 0 0
Chelsea	13,891	22,906 0 0	13,481 0 0	135	168	1 13 3	271,311 0 0	56 10 6	1 15 0
West Middlesex	16,000	45,500 0 0	18,000 0 0	155	185	2 16 10	404,263 0 0	68 8 9	3 0 0
Grand Junction	11,140	26,154 0 0	11,000 0 0	151¾	350	2 8 6	334,174 0 0	60 4 3	2 10 0
East London	46,421	45,234 0 0	15,889 0 0	107	120	1 2 9	594,988 0 0	118 19 11	3 15 0
South London	12,046	8,839 0 0	4,000 0 0	80	100	15 0	245,306 0 0	98 0 0	2 0 0
Lambeth	16,682	14,808 0 0	6,500 0 0	185	124	17 0	182,553 0 0	144 17 8	2 2 6
Southwark	7,100	7,850 0 0	No return.	60	156	1 1 3	95,000 0 0	One person's property.	No return.

* In this statement of annual expenses, there is no allowance to provide a fund for repairs, improvements, casualties, &c., which amount to a considerable sum.

† The average rate includes public buildings, breweries, distilleries, &c.; but the rate charged to many houses is only ten or twelve shillings; and all the water for extinguishing fires is gratuitously supplied—the conflagration of a single house commonly requiring from 700 to 1000 hogsheads.

The number of houses supplied in 1820, was 120,732; in 1827, 176,205; in 1833, 199,493; which shows an increase of 78,761 during thirteen years, although considerably more than 10,000 houses have been taken down to effect various improvements, &c., and none erected on the same sites.

Progress of Physical Science.

On some elementary laws of Electricity, by W. Snow Harris, Esq. F. R S.

(continued from p. 70.)

7. The inductive effect of a quantity of electricity distributed upon a conductor is directly as the quantity and inversely as the distance between the electrified body and that in which induction is produced.

Induction is not modified by atmospheric pressure being the same in the air and in a partially exhausted receiver.

8. The attraction of an electrified disk for a neutral uninsulated one, varies inversely as the square of the distance between their planes, supposed to be parallel.

(*a*) This force is not at all influenced by the force or disposition of the unopposed portions of two conductors, being the same in disks as when they are backed by hemispheres, cones, &c. Two hemispheres therefore attract each other with the same force as two spheres of the same radii.

(*b*) The attracting force is as the number of attracting points directly, and their distances inversely.

(*c*) The attraction between two unequal circular areas is equal to that between two areas each equal to the lesser.

(*d*) The attraction between a circular ring and a circle is the same as between two rings.

(*e*) The attraction between a sphere and a spherical segment of the same curvature, is the same as between two spherical segments equal to the one used.

A point may be determined in each of two hemispheres where the whole attractive force may be supposed to reside. The distance of this point from the intersection of the line of nearest approach of the spheres with the spherical surface is $z = \frac{(a^2 + 2\,ar)^{\frac{1}{2}} - a}{2}$, where a is the least distance between the spheres and r the radius of each. The attractive force will vary as $\frac{1}{a\,(a + 2\,r)}$.

9. "It is demonstrated, that the resistance of the air to the passage of electricity is as the square of the density directly, so that a given quantity, having a given intensity, and about to discharge [from] or flow upon a given point, will remain in the same relative state in air of half the density, if the distance between the points of discharge be doubled; or generally if as the density of the air be decreased the distance between the points of action be increased, the electrical accumulation will still remain complete. If therefore, the density of the air be indefinitely diminished, and the distance between the points of action indefinitely increased, we shall have eventually the same relative electrical state continued, without dissipation; so that if we imagine the opposed body to become nothing, then the accumulated electricity will not tend to leave the electrified body at all, supposing it to be without the influence of all other substances. Discharges of electricity under a diminished atmospheric pressure do not seem to occur so much in consequence of a tendency of the electric principle to evaporate, as it were, in all directions into space, but rather in consequence of the removal of the non-

conducting particles interspersed between the points, *from* and *towards* which, the accumulated electricity tends to flow. It is hence extremely doubtful, whether a general distribution of electricity in mere space would ever occur, supposing the electrified substance to be the only existing body in the universe: directly, however, that we assume the existence of another body, there is a space devoid of resistance, the resulting induction would generate an attractive force, which, however small, would cause an electrical current to flow through a distance, however great."

This most singular deduction is supported by the following direct experiments. A sphere of brass was placed in the centre of a glass globe and supported there by a brass stem which was connected with a delicate electroscope. No collapse of the leaves of the electroscope had occurred when $\frac{59}{60}$ths. of the air had been withdrawn from the globe.

Under an adequate attractive force electricity passes more readily over the surface of bodies in a rarified medium.

10. The recession of electrified bodies from each other does not depend upon the action of the air in which they are placed, the repulsion of two gold leaves placed in a larger receiver being maintained undiminished when $\frac{299}{300}$ths. of the air was withdrawn.

"Electrical divergence is, unquestionably, an extremely intricate phenomenon. If it be assumed to depend on a repulsive force immediately impressed upon the molecules of certain kinds of matter, then it must be admitted to be a species of repulsive action essentially different from any repulsive agency in nature of which we have the least experience. Its operation is at great distances, and is exerted between distinct and concentrated accumulations of the repulsive matter disposed on the surfaces of bodies; and whilst thus exerted at sensible distances, it is either altogether controlled by some other force, or otherwise so feeble as to be incapable of producing an electric diffusion by expansion, under an extremely diminished atmospheric pressure."

Experiments to measure the velocity of Electricity, and the duration of Electric Light. By Charles Wheatstone, Esq., *Professor of Experimental Philosophy in King's College, London.*

The continuance for a certain time of all luminous impressions on the retina prevents our accurately perceiving, by direct observation, the duration of the light which occasions these impressions; but by giving the luminous body a rapid motion, which produces the appearance of a continued train of light along the path it has described, its condition at each moment may be ascertained, and consequently its duration determined. The same law of our sensations precludes us from direct perception of the velocity with which the luminous cause is moving, as the whole of its track, for a certain distance, appears to be equally illuminated; but by combining a rapid transverse motion of the body from which the light proceeds, with that which it had before, its path may be lengthened to any assignable extent, and both its duration and its velocity will admit of measurement. The author gives various illustrations of this principle, and of his attempts to apply it to appreciate the duration and the velocity of the electric spark. His first experiments were made by revolving rapidly the electric apparatus giving electric sparks; but in every instance they appeared to be perfectly instantaneous.

He next resorted to the more convenient plan of viewing the image of the spark reflected from a plane mirror, which, by means of a train of wheels, was kept in rapid rotation on a horizontal axis. The number of revolutions performed by the mirror was ascertained by means of the sound of a siren connected with it, and still more successfully by that of an arm striking against a card, to be 800 in a second. The angular motion of the image being twice as great as that of the mirror, it was easy to compute the interval of time occupied by the light during its appearance in two successive points of its apparent path, when thus viewed; and it was ascertained that the image passed over half a degree (an angle which being equal to about an inch, seen at a distance of ten feet, is easily detected by the eye) in the 1,152,000th. part of a second. The result of these experiments, as regarded the duration of the spark, was that it did not occupy even this minute portion of time; but when the electric discharge of a battery was made to pass through a copper wire of half a mile in length, interrupted both in the middle, and also at its two extremities, so as to present three sparks they each gave a spectrum considerably elongated, and indicated a duration of the spark of the 24,000th part of a second. The sparks at both extremities of the circuit were perfectly simultaneous, both in their period of commencement and termination; but that which took place in the middle of the circuit, though of equal duration with the former, occurred later, by at least the millionth part of a second, indicating a velocity of transmission from the former point to the latter, of nearly 288,000 miles in a second; a velocity which exceeds that of light itself.—*Proceedings of the Royal Society, June* 14, *quoted in Arcana of Science*, 1835.

On the Repulsive Power of Heat. By the Rev. Baden Powell, *Savilian Prof. Geom. Oxford.*

Prof. Powell examines an experiment of Signor Libri, from which the repulsive power of heat was inferred, namely that when a drop of water was placed near the end of a wire placed horizontally, or even inclined a little upwards, on heating the wire the drop receded from the heated part. A repetition of this experiment produced only a slight motion explicable by the increased vaporization on the side next to the heated part of the wire. A drop of oil placed in a capillary tube, when part of the tube is heated, recedes from the place of heat, because the tube is rendered slightly conical. No effect was produced on liquids contained in capillary tubes though heated until they boiled, nor on a drop between two inclined plates which were heated, nor on a globule of mercury suspended from a glass plate, by heating the plate.

Mr. Fresnel placed disks of foil and mica before a delicately suspended magnetic needle, and brought them against fixed disks, when the needle was a little inclined to the meridian so as to press the disks together. On applying the heat of a lens to the disks they separated. The experiment was made in a highly rarified medium. Professor Powell repeated the experiment, remarking that the effects might be produced by the greater heat of the surface exposed to the sun's rays, which would render it convex. By pressing the disks closely together, the coloured rings formed would give a test of the interval between the disks. The tints invariably descended in the scale when heat was applied, showing that the intervals between the disks increased. By using two lenses the exact amount of the interval may

be calculated. The effect of expansion will be, when a convex lens is placed upon a plane, or convex, or even upon a concave surface of less curvature than the lens, to diminish the angle between the lens and surface, and so to cause the rings to enlarge. But on the contrary they regularly contract and the central tint descends in the scale until the whole vanishes, by an increase of interval. This it would seem must be due to a real repulsive power developed by heat.

From experiments made by the contact of a lens with different substances, Prof. Powell infers that whatever tends to increase the rapidity of communication of heat, tends to increase the observed effect. The effect is increased when water instead of air is introduced between two lenses.

Abstract fr. Royal Soc. Trans.

The Aurora Borealis as a Prognostic of the Weather.

The view intended to be enforced in the following extracts is that a display of the Aurora is immediately succeeded by high winds and storms.

1. *Notice of instances of the appearing of the Aurora Borealis, seen from Dundee, Perthshire, in* 1833 *and* 1834, *and the state of the weather subsequent to the several instances. By* Wm. Gardiner, Jr. Esq.

"These northern illuminations have been very frequent of late as the subjoined list of dates of their occurrence in 1833 and 1834 will show. From circumstances, I have been unable to make scientific observations on these interesting phenomena, but the statements I communicate are facts, and facts however simple and apparently of little value in themselves, often come to be useful. The object I have in view, you will perceive, is to establish that the Aurora may be relied upon as a sure prognostic of the weather. From the observations which I now bring forward, as well as a multitude of similar ones made prior to 1833, I have learned that an Aurora is *always* succeeded by moisture, and frequently by storms, that are in general, proportionate to the brightness, extent and length of duration, of the luminous manifestation"—[*Loudon's Mag. of Nat. Hist. No.* 46.

2. *Remarks Contributive to the Elucidation of Meteoric Atmospheric Phenomena. By* W. H. White, Esq.

I have been thus particular in a detailed account of the weather during the latter part of December 1830, because I have generally found variable and stormy weather to succeed Auroras, particularly if they were accompanied with many meteoric appearances. During the period of my observations of atmospheric and meteoric showers, I have invariably found that a gale of wind, generally from the S. or S. W. has followed an aurora within thirty hours, or at most thirty six hours; but differing in degree according to the splendour and magnitude of the aurora, and meteoric appearances; and therefore I think the following observations will hold good. The more splendid and active an aurora is, the more violent, and, consequently, in the shorter period, is the gale that succeeds, and the shorter its duration; and on the contrary, the more languid and dull the aurora appears, the longer the gale is in approaching, the less its violence, and also the longer its continuance. I should feel obliged by the observations of other gentlemen on this interesting subject, because, if the fact be universally true, particularly in high latitudes, of what importance would it be to our navigators, especially in the Northern Ocean, to pay particular attention to those interesting phe-

nomena, as they might be enabled to prepare against the storm which that appearance may be said to predict.—[*Loudon's Mag. Nat. Hist. No.* 46.

Old Kent Road, Dec: 10th, 1834.

3. *Aurora Borealis, of Oct.* 12, 1833.—Mr. Fielding who describes a splendid display of the Aurora, seen at Hull, England, on the evening of Oct. 12, 1833, states that it was followed by a sudden fall of temperature in the air. The wind on the next day was from the east, inclining to the south, and in the evening blew in gusts from the south west. There were showers of rain on the evening of the 13th.—[*Loudon's Mag. Nat. Hist. No.* 37.

Dark Colour of the Sky at Considerable Heights in the Atmosphere.

Dr. Barry read a paper on the dark colour assumed by the sky in the higher regions of the atmosphere, and instanced his own observations on ascending Mont Blanc. At a particular elevation, when surrounded by fields of snow, the sky deepened in tinge, and became dark violet; this he endeavoured to prove to be the effect of certain rays emanating from the snow, and received upon the retina of the eye. In order to shut out this influence, he stretched himself on his back, and giving the eye a short rest, the dark colour disappeared, and various shades, more or less, developed as he shut out or admitted those rays, to his vision. These various shades, and the corresponding influences which gave rise to them, he very ingeniously reduced to a scale, and illustrated them by comparison with the various tints afforded in the decomposition of light by the agency of the prism. [*Proceedings of Brit. Assoc.—Rep. Pat. Inv.*

Civil Engineering.

Observations on the Motions of Shingle Beaches. By Henry R. Palmer, *Civil Engineer.*

The object of Mr. Palmer is exclusively practical, and his observations intended to furnish rules for controlling the motions of a beach, so far as to preserve a clear channel through it at all seasons, and in every variety of weather.

1. The motions to be explained. That the pebbles which compose the shingle beaches on these coasts, [Kent and Sussex, Eng.] are kept in continued motion by the action of the sea, and that their ultimate progress is in an easterly direction, are facts long known, and commonly observed. The following observations are chiefly directed to the particular manner in which the motions are produced.

From a general view of the effects which I have noticed, it appears that the action of the sea upon the loose pebbles is of three kinds; the first heaps up, or accumulates, the pebbles against the shore; the second disturbs, or breaks down, the accumulation previously made; the third removes, or carries forward, the pebbles in a horizontal direction.

For convenience, I propose to distinguish these by the following terms, viz: the first, the accumulative action; the second, the destructive action; the third, the progressive action.

All the consequences resulting from these various actions are exclusively referable to two causes; the one to the currents, or the motion of the gener-

al body of the water in the ebbing and flowing of the tides; the other to the waves, or that undulating motion given to the water by the action of the winds upon it; and it is of considerable importance to the present inquiry, that the effects resulting from each specific cause be separately considered.

The motion of the shingles along the shore is commonly attributed to the currents, the action of the waves being considered only as a disturbing force.

That the current is not the force which moves the pebbles along the coast, will appear from the following reasons.

1st. If it were so, the direction of the motion of the pebbles would be determined by the currents; but while the direction of the currents will vary with the change of the tides, we find that the direction of the pebbles may remain unaltered; and also, that the motion of the pebbles is continued when no current exists.

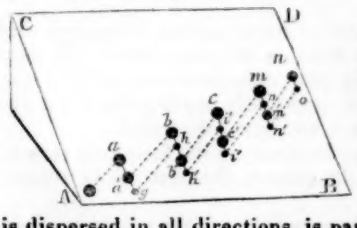
2d. Although the velocities of the currents may not have been ascertained with precision, yet it is known that the velocities, generally, along this coast, which can possibly act on the shingles, are not sufficient to give motion to pebbles of every dimension, which are, in fact, carried forward.

3d. That the motion of a current will not produce that order in which the pebbles are found to lie, which order, as will hereafter be shown, may easily be distinguished as the effect of the motion of the waves only.

The direction of the waves is determined principally by the wind, the prevailing direction of which, on the coasts referred to, is from the westward. Every breaker is seen to drive before it the loose materials which it meets; these are thrown up the inclined plane on which they rest, and in a direction corresponding, generally, with that of the breaker. In all cases, we observe that the finer particles descend the whole distance with the returning breaker, unless accidentally deposited in some interstices; but we perceive that the larger pebbles return only a part of the distance, and, upon further inspection, we find that the distance to which each pebble returns, bears some relation to its dimensions. This process is an indication of the accumulative action.

But, under some circumstances, depending upon the wind, it is found that pebbles of every dimension return with the breakers that forced them up the plane, and that these are accompanied also by others, which have been previously deposited, but which are, in such cases, disturbed by the waves; and by a continued repetition of the breakers acting in this manner, the whole of the shingle previously accumulated is immersed below the surface of the water. This process is an indication of the destructive action.

The particulars of the accumulative action, *combined with that of progression*, are explained as follows.



Let A B C D be an inclined plane, representing that on which the loose pebbles move. Suppose the wind to blow in such a direction as to cause a wave to strike a pebble at A, in the direction of A, *a*, and to the distance (*a*) up the plane, that point being the extent to which the force can reach. Now here the wave breaks partly into spray, and is dispersed in all directions, is partly absorbed, and descends in a shallow form, which rapidly diminishes in its depth, so that the pebble is soon left

exposed, and, therefore, does not return the whole distance with the water, but is left at rest at *a'*, being at a higher level than that from which its motion commenced.

With the rise of the tide, the striking force is also elevated; and by the repetition of the operation described through the different heights in succession, the further motion of the pebble will be represented by *a b c m*, &c., the distance in each step of its descent being something less than in that of its ascent, until it has reached the summit (*n*) determined by the height of the tide. Now, if we suppose a pebble of less dimension than the former to be struck from the same point, we shall find it raised as before; but, because its surface is greater in proportion to its weight, and because, from its less bulk, it remains longer immersed in the declining wave, it will descend further, and follow the line *a g*, &c., and will not be left at rest till it has reached *o*.

So much effect has been attributed to the motion of the tidal currents, that vast sums have been expended in attempts to divert the motion of the shingles to a distance from the shore, from whence, by the increased depth and velocity of the current, it has been expected they would be carried past a particular spot, through which a permanent open channel has been required. Such attempts have been made at various periods, during upwards of two centuries, at Dover, and more recently at Folkstone, in the same neighbourhood. It is hardly necessary to observe, that they have not been successful, and, from the principles which I have laid down, their failure may easily be accounted for.

If a wall, or pier, be extended from the shore into the sea, it is evident that such erection will, in the first instance, impede and prevent the progressive motion; that motion is again restored, and the general mass proceeds as if no impediment had existed.

The most perspicuous evidence of these results is exemplified at the harbour of Folkstone.

Previously to the commencement of this exclusively artificial work, the beach traveled along the line of the cliff in the ordinary way.

By extending the walls a sufficient distance into the sea, it was expected that a commodious harbour would be formed, and the shingles diverted so far into deep water, that they could not again appear above the surface until they were removed beyond the harbour's mouth.

The accumulation, however, immediately commenced, and continued as the work advanced, until it became apparent that no other effect was produced upon it than a comparatively slight change of direction; the entrance of the harbour being much encumbered with shingle, an additional pier, or jetty, was erected, and extended about two hundred feet further into the sea, without having approached the effect intended. It is true, that some advantage was derived from the extended pier, by increasing the distance between the most violent action of the breakers, and the still water of the harbour. The shingles, therefore, pass the mouth in a more dispersed form than they originally did, and hence they do not as readily form a bar rier, neither does its perpendicular height become so great.

If, then, it be admitted that projecting piers will not prevent the encumbrance about the mouth of a harbour, situated, as those referred to, in the tract of the restless beach, it remains to be seen how far such works may be otherwise injurious.

While the accumulative action is going on, every abrupt projection from the coast is an impediment to the progressive motion of the beach, till its

angle is filled up. Such abrupt projections offer no protection against the destructive action; when, therefore, by the increase of the wind, the action of the sea becomes violent, an accumulation previously caused by a projecting pier is rapidly removed, and again is rapidly deposited where it is not resisted. And there is, perhaps, no combination of circumstances less capable of resisting, or more favourable to the deposition of, the shingle, than is found in artificial harbours, shielded by an *abrupt* weather pier on a line of beach.

With a long continuance of violent winds from the same quarter, every accumulation of loose shingle is broken down, and is hurried forward, whilst it unremittingly appears to seek protection. During the recent gales, every inlet within the tract of the beach was seriously encumbered with it, commenced with the heap accumulated by the very pier that was intended to prevent such an effect, (where such existed,) and increased by the successive arrivals of those more remote, together with that quantity commonly passing along the sloping plane, but now brought down by the destructive action, and forced along with accelerated motion.—[*Abst. Phil. Trans.* 1834.

Liverpool and Manchester New Canal.

We understand that it is intended to form a canal between Liverpool and Manchester, parallel with the famous rail-way, and nearly of the same length viz: thirty-two miles.

The new canal is intended for the cheaper conveyance of the passengers, luggage, light goods, and parcels which are now carried by the Liverpool railway coaches and wagons. This undertaking owes its origin to the unprecedented success, in point of despatch and cheapness, of the light passenger boats on the Scotch canals between Paisley, Glasgow, and Edinburg, and to the invention of a new apparatus for passing light boats rapidly up and down the ascents and descents of canals without loss of time or expenditure of water.

This apparatus is now in the process of being established on the Forth and Clyde canal. It is simple in its form and cheap in its construction, and from the length of the boats, being unrestricted by locks, a great additional buoyancy to the boats and consequent increase of their velocity is obtained.

With respect to the cheapness and speed of this conveyance, the experience of several years has now fully proved that passengers and light goods are easily and regularly conveyed on canals in light iron boats drawn by two horses, and accommodating from 100 to 150 passengers; at a speed of 10 miles an hour and upwards, and at fares less than one third of the Liverpool railway fares, and from thirty to forty per cent. less than the actual cost of outlaid expense of conveyance on the Liverpool railway, and it has also been ascertained that the speed on canals can, if necessary, be increased to twelve miles an hour.

The cost of making the new canal perfectly complete, is estimated at 250,000*l.* or nearly 8,000*l.* a mile. It will require no locks, and only a small reservoir to supply the evaporation of water in summer. It will have a towing path on each side; that is, one for the horses in each direction. The time consumed in the journey between Manchester and Liverpool, (including that of the omnibus conveyance at each end) will not exceed three hours; the great obstacle to speed arising from locks, and restricted length of the boats to suit the locks, being now removed.

The fares to passengers in the new canal, will not exceed the rates charg-

ed to passengers on the Paisley Canal, the average of which hardly exceeds one half penny per mile. The average fare on the new Liverpool and Manchester Canal will therefore be about one half penny per mile: or from seventeen pence to twenty pence for thirty-two miles, the distance between Liverpool and Manchester.

This average rate of fares is less than one-third of the average rate of fares exacted from passengers on the Liverpool railway, and from thirty to forty per cent. under what the Liverpool Railroad directors have, in their printed reports, stated to be their outlay on each passenger conveyed by them between Liverpool and Manchester. At this low rate of fares the proprietors of Scots canals, and particularly the Paisley Canal, have during the last four years, been increasing the number of their passage boats, and the frequency of their voyages or trips. On the Paisley canal the boats start from Paisley to Glasgow twelve times a day—that is hourly, and as often from Glasgow to Paisley.

There being little trade between Edinburgh and Glasgow, the trips of the boats on the canals between the two cities, are not so frequent as on the canal between Glasgow and Paisley. But the number of miles run by the passage boats on the canals between Edinburgh, Glasgow and Paisley daily, are upwards of nine hundred miles; whilst the total number of miles run daily by the passenger coaches and uncovered wagons on the Liverpool and Manchester railway, amounts only to 550 miles daily.

Another striking fact is certain. The gross amount of the fares levied daily for running these 900 miles on the canals, does not much exceed one-half of the sum stated by the railway directors as the actual cost of running 550 miles on the Liverpool railway. And yet a large proportion of the canal receipts are profits to the canal companies, who have been thereby induced to go on regularly in improving their passage boats, and increasing the number of their voyages.

On the canal between Liverpool and Manchester, it is proposed that a boat shall start from Manchester to Liverpool, and another boat from Liverpool to Manchester, at the end of every hour, for twelve hours daily, thus giving twelve opportunities from Liverpool to Manchester, and as many from Manchester to Liverpool, and running 768 miles daily, or 280,325 miles in the course of the year.

The boats are to be constructed and fitted up in the same manner as those on the Paisley canal, with two neat cabins, which will easily accommodate from one hundred and twenty to one hundred and fifty passengers, or three thousand six hundred passengers daily.

The cost of running these boats, stated at the same rates as on the Paisley canal, will be £11,000 yearly, including interest of the capital or cost of the boats and of the horses employed in drawing them, and a sinking fund to compensate their deterioration, and provide for their replacement.

The above calculations are based upon the actual cost of running exactly similar boats and some larger boats on the Scots canals. From the great extent of the trade, wealth and population of Manchester and Liverpool, compared with Paisley and Glasgow, the quantity of passengers and goods conveyed on the canals between Paisley and Edinburg, must be altogether trifling compared to that which will be conveyed by the canal between Manchester and Liverpool; and judging from what has already been effected by the increased speed and unparalleled cheapness of the improved iron boats on the Scots canals, it is calculated that the light iron boats on the new canal between Manchester and Liverpool will be amply supplied with goods

and parcels, and that the revenue arising from the trade will be at least 20 per cent. on the capital expended.

A very large revenue, also, may be assuredly expected from night boats, carrying light goods, parcels, luggage and passengers, at lower rates than during the day, as has for several years been done on the Forth and Clyde, and Union Canals between Edinburgh and Glasgow. In these night boats the charge for a parcel not exceeding one stone in weight will be only 4d. which is just one third of the Liverpool Railway charge.

When it is considered that the average fares to passengers on the famous Liverpool Railway are from triple to quadruple the average fares in the neat and comfortable cabins of canal passage boats, running ten miles an hour, and that many of the railway passengers are conveyed in uncovered wagons, the success of the proposed undertaking may be considered as perfectly secure. For even supposing the railway company (encouraged by their corporate privilege exempting the partners from being liable for the debts of the corporation) were to reduce the fare of their passengers to the mere outlay or cost of the conveyance, it will be from thirty to forty per cent. above the canal fares, which after defraying all expenses, afford a handsome profit or dividend to the canal proprietors.

Unlike the railway, the new canal will furnish accommodation to all the country on its route, equal to that given by the railway to the towns only at each extremity; for passengers on the canal can be received or landed by the boats whenever required.

The whole line of the canal may thus, from frequency and ease of access, become like a main street connecting Liverpool and Manchester, and furnish sites for all kinds of manufacturing and chemical establishments, the canal affording a constant and abundant supply of water.

As soon as the new canal is fairly established and the quiet, smoothness, speed and unrivalled cheapness of the conveyance are experienced, we may expect to have opportunities not merely every hour, but every half hour, of passing between Manchester and Liverpool, at one third of the expense by the railway.—*London Public Ledger.*

Mechanics' Register.

Authorship of an improved method of setting rails.—A suggestion to the following effect will be found in Prof. Barlow's report, page 127, vol. xvi. of this Journal. "I suggest as a matter deserving the attention of practical men, that as the bar must necessarily contract, it will draw from that end which is least firmly fixed, and hence all the shortening will probably be exhibited at one end however slight the hold on either may be; and when it happens that the adjacent ends of two bars both yield, the space is double. To avoid this evil, one of the two middle chairs in each bar might be permanently attached to the rail, in which case the contraction must necessarily be made from each end."

In a very rough article in the August number of the London Mechanics' Magazine the credit of the suggestion is claimed by Mr. James Woodside, one of those competitors whose plans Prof. Barlow examined. In the mildest tone of rebuke, the Professor replies, admitting that the suggestion is certainly due to Mr. Woodside, although he had not recollected having so derived it when his report was written, and adding that while Mr. W. was certainly right as to *fact* he was certainly wrong as to *motive*.

We could wish that similar admission, as to facts, had been made by the re-inventors of Hare's Compound blow-pipe and of the jet attached thereto. The second inventors were Mr. Rutter and Prof. Daniell of England.* B.

Hancock's Steam Carriage.—A correspondent of the London Mechanic's Magazine states that the journey from London to Hounslow, the distance being 75 miles has been performed, going and returning at the rate of about 9¾ miles per hour. The stoppages swelled the time of each jaunt to nearly twelve hours.

Maudesley and Field's Steam Carriage.—From the same source it appears that the jaunt above referred to has been made by a steam carriage of Maudesley and Field. The rate about ten miles per hour. The time out 8h. 10m. and back in 11h. 22m. including stoppages.

Experiments for the safety of the Steam Engine.—Under the act of the 30th of June, 1834, "authorizing the Secretary of the Navy to make experiments for the safety of the steam engine," and appropriating five thousand dollars for that purpose, many proposed improvements have been submitted for the purpose of being tested by experiments. Some of these were so easily tested by those having steam engines in operation, that the aid of Government was not needed: others were attended with greater difficulty, and could not be tested without the expense of constructing boilers and other machinery for the purpose. These proposed improvements have not been such, as in my opinion, to warrant a large expenditure of money; and no experiments have been made upon them. Such experiments, however, would have been made, if they could have been made without the expense of constructing engines.

"The act seemed particularly to require that the steam engine devised by Benjamin Phillips, of Philadelphia, should be examined and tested; and that Mr. Phillips should be employed in making the experiments. Mr. Phillips was therefore employed to construct a model engine, with boilers and other machinery which he deemed necessary for the purpose of testing his improvements, which he brought to this District, where he remained several weeks making his experiments before many members of both Houses of Congress, before the officers of the different Departments, and others.

"I attended very carefully to these experiments; but have not been able to perceive in them any improvements, increasing the safety of the steam engine."—[*Rep. of Sec. of Navy to Congress*, 1835]

New African Expedition of Discovery.—This project is to begin the exploration to the south, and to travel northward, by caravan. The district to be explored is that between the termination of Denham and Clapperton's discoveries to the north and Campbell's and others to the south. It comprehends about 30° of latitude. Attempts were making in London to procure subscriptions for the outfit and maintainance of the expedition.

Undulating Railway.—Arguments on this subject are still presented both pro and con. A one sided view of it has been taken in this journal, but one which has not been satisfactorily refuted: see the report of R. Stephenson, Jr., vol. xv., p. 1. and an article in vol. xii., 1833.

Mechanical Knighthood.—Mr. Stephenson has been appointed a knight of the order of Leopold.

Cooking by Gas.—It is stated in the London Mechanics' Magazine, that with no more complex contrivance than a sheet iron cylinder covered with wire gauze, and placed over a gas light, two quarts of water in a common copper tea-kettle may be boiled by the consumption of three cubic feet of

* See this Journal, vol. xi., p. 149.

gas. The gas issuing from the jet pipe mixes with the air in the cylinder, and the mixture is set fire to above the wire gauze.

Howard's Quicksilver Engine.—A trial of this engine, which uses the vapour of mercury as a moving power, is to be made at Lisbon in the steam packet Comet.

Current through the Straits of Gibraltar.—A writer in the Nautical Magazine for September, explains thus the current which sets constantly from the Atlantic to the Mediteranean through the straits of Gibraltar. The specific gravity of the water of the Mediterranean has been ascertained to be 1030 while that of the Atlantic is but 1028. The depth between Ceuta and Europa point is 4200 feet. A column of water of the specific gravity of 1030, and of the height of 4200 ft. would balance one of the specific gravity of 1028 and of the height of 4208¼. The difference of level of the two seas if a barrier were placed across the surface, and equilibrium produced by pressure on the water below, would be 8¼ feet. The waters of the Atlantic tend to press in therefore at the surface, while the denser water of the Mediteranean flows out at the bottom. Observations in proof of such an under current have been made.

List of Patents which issued in November, 1835.

		November
682.	*Prussiates, making and dying with.*—Felix Fossard, City of Philadelphia,	7
683.	*Cutting Straw*, &c.—Henry C. Jones, Rochester, Ohio,	7
684.	*Charcoal Kiln.*—E. B. Gilbert, Euphrata, New York,	7
685.	*Horse Rake.*—James Pudney, Stanford, New York,	7
686.	*Crackers, cutting.*—L. P. Clarke, Baltimore, Maryland,	7
687.	*Cutting Straw.*—Ashman Hall, Putnam County, New York,	7
688.	*Grist Mill.*—Philip Hauser, New Haven, Connecticut,	7
689.	*Rotary Steam Engine.*—John G. Hotchkiss, New Haven, Connecticut,	7
690.	*Smut Machine.*—John Tuck, Columbus, Pennsylvania,	7
691.	*Canal Steam-boat.*—John Elgar, Baltimore, Maryland,	7
692.	*Rail road and Canal Transportation.*—John Elgar, Baltimore, Maryland,	7
693.	*Balance for Counters.*—Elias A. Hibberd, Lunemberg, Vermont,	7
694.	*Tanning, extract of Bark for.*—Otis Batchelder, Bedford, New Hampshire,	7
695.	*Horse Collars.*—H. C. Call, Sterling, Connecticut,	14
696.	*Screen for Grain.*—E. P. Fitzpatrick, Mount Morris, New York,	14
697.	*Anti-friction box.*—E. Fisk, and J. C. Green, Fayette, Maine,	14
698.	*Steam engine, centrifugal.*—Charles J. Conway, city of New York,	14
699.	*Cisterns, &c., water proof.*—Levi Kidder, city of New York,	14
700.	*Anodyne sirop.*—Rezin Thompson, Rome, Tennessee,	14
701.	*Floating dry dock.*—Rufus Porter, Bellerica, Massachusetts,	14
702.	*Smut machine.*—E. P. Fitzpatrick, Mount Morris, New York,	14
703.	*Japan for leather.*—William Gates, Hanover, New York,	14
704.	*Fireplace, &c.*—J. Douglass, S. Durham, Maine,	14
705.	*Truss for hernia.*—V. Wilkinson, city of New York,	14
706.	*Hair, extracting from skins.*—Nahum Swett, Readfield, Maine,	14
707.	*Truss for hernia.*—Robert Semple, Vandalia, Louisiana,	14
708.	*Propelling by screw.*—E. P. Fitzpatrick, Mount Morris, New York,	23
709.	*Cheese press.*—W. C. Greenleaf, Andover, Maine,	23
710.	*Spark catcher.*—G. Holbrook, Boston, Massachusetts,	23
711.	*Feathers, dressing.*—B. Smith, Schodack, New York,	23
712.	*Medicine administered by steam.*—Ben. Grut, city of New York,	23
713.	*Sopha, &c., springs for.*—E. Cherrington, Boston, Mass.	23
714.	*Bedstead and mattress.*—E. Charrington, Boston, Mass.	23
715.	*Rail-roads.*—E. Johnson, Rochester, New York,	23
716	*Horse shoe machine.*—Henry Burden, Troy, New York,	23

717. *Spring saddle.*—Adam Hickman, Abingdon, Virginia, 23
718. *Floating dry dock.*—J. R. Campbell, and J. S. Withington, Boston, Mass., 26
719. *Steam boilers.*—Thomas Ashcroft, Boston, Mass. 26
720. *Chilling castings.*—Henry Saunders, Greensburg, New York, 26
721. *Mortising machine.*—J. M'Bride, Richmond, Indiana, 26
722. *Turnabouts for rail-roads.*—David Evans, Philadelphia county, 26
723. *Canal boat, sheet-iron.*—L. Parmellee, Poughkeepsie, New York, 26
724. *Spring saddle.*—Charles Bates, Staunton, Virginia, 26
725. *Water wheel.*—Edward Newman, Stilesville, Indiana, 26
726. *Asbestos, application of.*—John Scott, Philadelphia, 26
727. *Sheet-iron fireplace.*—Gilbert Richards, Ashfield, Mass. 26
728. *Cotton seed huller.*—John Ambler, Jr., Philadelphia, 26
729. *Hydrant.*—Sater T. Walker, Baltimore, Maryland, 26
730. *Grist mill.*—Samuel Hyde, Malone, New York, 26
731. *Saw.*—John Ruthven, city of New York, 26
732. *Spark catcher.*—J. W. Waples, Wilmington, Delaware, 26
733. *Cloth winding machine.*—J. Goulding, and J. Brackett, Boston, Mass. 26
734. *Diving dress.*—J. R. Campbell, Boston, Massachusetts, 26
735. *Kiln for grain.*—Thomas Crook, New Hope, Pennsylvania, 26
736. *Hot air hearth.*—L. V. Badger, and R. Walker, Portsmouth, N. H. 26
737. *Cutting straw.*—John Wirt, Evansham, Va. 26

List of Patents which issued in December, 1835.

December

735. *Cupola Furnace.*—L. V. Badger, Portsmouth, New Hampshire. 2
736. *Pencil and crayon points.*—George C. Baldwin, Ticonderoga, N. Y. 2
737. *Smoothing metals.*—Bradford Seymour, Utica N. Y. 2
738. *Rail road car wheels.*—Arundius Tiers, Kensington, Penna. 2
739. *Sunken vessels, raising.*—W. Atkinson and E. Hale, City of New York, 2
740. *Water-proof boots.*—David Clarkson, City of New York, 2
741. *Brakes for cars, &c.*—John K. Smith, Port Clinton, Pa. 2
742. *Drilling rock*—Aaron Van Cleve, Stonington, Conn. 2
743. *Iron pipes, casting.*—John D. Morris, Kensington, Pa. 2
744. *Cooking stove.*—Henry Stanley, Rutland County, Vermont, 2
745. *Weaving stock frames.*—F. Goodell and T. W. Harvey, Ramapo, N. Y. 2
746. *Clover seed, hulling.*—George W. Taylor, Bridgetown, N. J. 4
747. *Cooking stove.*—Bennington Gill, City of N. Y. 9
748. *Cutting straw, &c.*—Leonard Marsh, Windsor County, Vt. 9
749. *Hats, traveling.*—V. De Brain, City of N. Y. 9
750. *Truss for prolapsus, &c.*—John F. Gray, City of N. Y. 15
751. *Fire place.*—Charles Lane, Hingham, Mass. 15
752. *Pressing brick.*—Ulysses Ward, Washington City, 15
753. *Flour bolt.*—Aritus A. Wilder, Mount Morris, N. Y. 15
754. *Laths, cutting.*—Barnabas Langdon, Troy, N. Y. 15
755. *Tobacco press.*—John W. Weems, West River, Md. 15
756. *Buckwheat, cleaning.*—Daniel T. Laning, Cumberland County, N. J. 15
757. *Sharpening razors, &c.*—William Child, Baltimore, Md. 15
758. *Water cistern.*—Alfred Palmer, Syracuse, N. Y. 16
759. *Lamp.*—Cyrus Rust, City of N. Y. 28
760. *Door locks.*—J. K. & H. C. Campbell, Charleston, Mass. 28
761. *Steam gauge.*—Samuel Raub, Jr. Wilkesbarre, Pa. 28
762. *Thrashing grain.*—Moses Davenport, Phillips, Somerset County, Md. 28
763. *Cleaning feathers.*—Edmund Wood, Owego, Tioga County, N. Y. 28
764. *Brick machine.*—Benjamin Hamblet, Portland, Me. 28
765. *Amalgamating mill.*—J. Curtis, N. Y. 28
766. *Amalgamating mill.*—J. Curtis, N. Y. 28
767. *Amalgamating mill.*—J. Curtis, N. Y. 28
768. *Cam press, &c.*—Alonzo S. Grenville, Cambridgeport, Mass. 30
769. *Ironing, &c. clothes.*—Samuel Swett, Jr. Readfield, Me. 30
770. *Thrashing machine.*—Amos Hanson, Windham, Me. 30
771. *Mowing machine.*—A. M. Wilson, Rhinebeck, N. Y. 30
772. *Clock escapement.*—James Fulton, Shelby County, Ky. 30

CELESTIAL PHENOMENA, FOR MARCH, 1836.

Calculated by S. C. Walker.

Day.	H'r.	Min.				
1	7	36	Im. „ Leonis,	,3,4,	N. 73°	V. 25°
1	8	52	Em.		238°	191°
4	12	16	N. App. ☽ and γ′ Virginis, ,4,		☽ North 2.′3	
8	16	26	N. App. ☽ and ζ Ophinchi, ,5,		☽ South 2.′5	

Meteorological Observations for November, 1835.

Moon.	☉		☾		⊗		☽		Days.	Therm.		Barometer.		Wind.		Water fallen in rain.	State of the weather, and Remarks.
										Sun rise.	2 P. M.	Sun rise.	2 P. M.	Direction.	Force.		
									1	37°	46°	Inches 30.45	Inches 30.30	E.	Moderate.		Clear day.
									2	38	54	.35	.15	N.E.	do.		Lightly cloudy—cloudy.
									3	30	60	.00	.30	W.	do.		Cloudy—lightly cloudy.
									4	30	66	.00	.06	S.	do.		Fog—hazy.
									5	54	61	.00	29.95	S.W.	do.		Dense fog—cloudy.
									6	53	52	29.95	.96	S.E.	do.		Cloudy—do.
									7	49	57	.85	.85	S.E.	do.	.16	Rain—cloudy.
									8	47	59	30.00	30.00	S.S.E.	do.		Drizzle—cloudy.
									9	53	59	29.80	29.80	S.E.	do.	.55	Rain—clear.
									10	42	51	.85	30.00	N.W.	do.		Clear—rain in the night.
									11	52	51	29.10	.10	S.	Blustering.	1.02	Rain—flying clouds.
									12	38	44	.50	.40	W.	Moderate.		Cloudy—flying clouds.
									13	34	36	.80	.90	W.	do.		Cloudy—clear.
									14	36	46	30.00	30.00	N.W.	do.		Clear—lightly cloudy.
									15	46	45	29.90	29.98	S.E.	Calm.	.10	Cloudy—lightly cloudy—rain.
									16	35	42	.80	.73	S.W.	Brisk.		Cloudy—do.
									17	46	55	.90	.80	N.W.	Moderate.	.10	Cloudy—Aurora Borealis.
									18	44	61	.84	.85	S.W.	do.		Cloudy—rain.
									19	46	49	.85	.85	S.W.	Calm.	.10	Cloudy—foggy.
									20	50	50	.65	.85	S.W.	Moderate.		Mist—partially cloudy.
									21	49	53	.80	.90	W.	do.		Cloudy—lightly cloudy.
									22	37	36	30.20	.85	N.	do.		Cloudy—lightly cloudy.
									23	32	33	.00	.75	N.E.	do.	1.15	Snow—drizzle.
									24	35	35	29.80	.95	N.	do.		Sleet—rain.
									25	29	37	30.05	30.12	N.W.	do.		Cloudy day.
									26	24	37	.05	.03	W.	do.		Clear—lightly cloudy.
									27	29	35	.00	.06	N.W.	do.		Lightly cloudy.
									28	32	38	29.75	29.75	N.E.	do.	.05	Cloudy—snow.
									29	19	24	.70	.75	W.	do.		Lightly cloudy.
									30	20	35	.85	.76	W.	Brisk.		Clear day.
									Mean	39.96	44.50	29.88	29.85			3.33	Cloudy day.

	Thermometer.	Barometer.
Maximum height during the month,	66. on 4th.	30.45 on 1st.
Minimum do.	19. on 29th.	29.10 on 11th & 12th.
Mean do.	44.23	29.86

Note to Readers.—In order that the Selections might not be crowded out of the present number, an extra form of twelve pages has been added. The paging is the same as that of the preceding form, with "bis" added.

The report of the Committee on Explosions will be continued in the next number, and concluded in the following one. COM. PUB.

Erratum.—In the list of patents for 1835, the final number, 772, is correct. The last three numbers for November, and the first three for December, are the same, owing to certain patents having been erroneously marked as issued in the Patent Office.